COMPRESSED AIR

AND EVERYTHING PNEUMATIC.

Vol. XIII SEPTEMBER, 1908 No. 9

A VARIABLE VOLUNE AIR COMPRESSOR

VARYING DELIVERY BY QUARTER LOADS WHILE MAINTAINING FULL COMPOUND EFFICIENCY.

BY H. V. HAIGHT.*

The machine illustrated is a duplex-tandem compound compressor, each side being practically a complete machine. The principal dimensions are as follows: Diameter each, low-pressure cylinders, 25 inches; diameter each, high-pressure cylinders, 16 inches; stroke, 36 inches; revolutions per minute, 85; displacement, cubic feet free air per minute, 3,474; rope wheel, diameter 16 feet; diameter of ropes, 1 inch; number of rope grooves, 18; weight of wheel, 26,000 pounds; weight of base plate, 25,000 pounds; total weight of machine, 110,000 pounds; horse-power of driving motor, 600.

This compressor was built for British Columbia, where most of the large motor-driven compressors in Canada are located. Practically all of the large motor-driven compressors in British Columbia are driven by ropes, on the Dodge-American system, with long centers, usually 55 feet. The diameter of the ropes is usually 1¼ or 1½ inches. Fig. 1 is not the one belonging to the compressor, as its own wheel had already been shipped. It has a double set of arms, and there is an arm close to the joint on each side to support the heavy lugs. The net area of the bolts in the rim joint is about 23 per cent. of the net area of the rim. At the rated speed of 85 revolu-

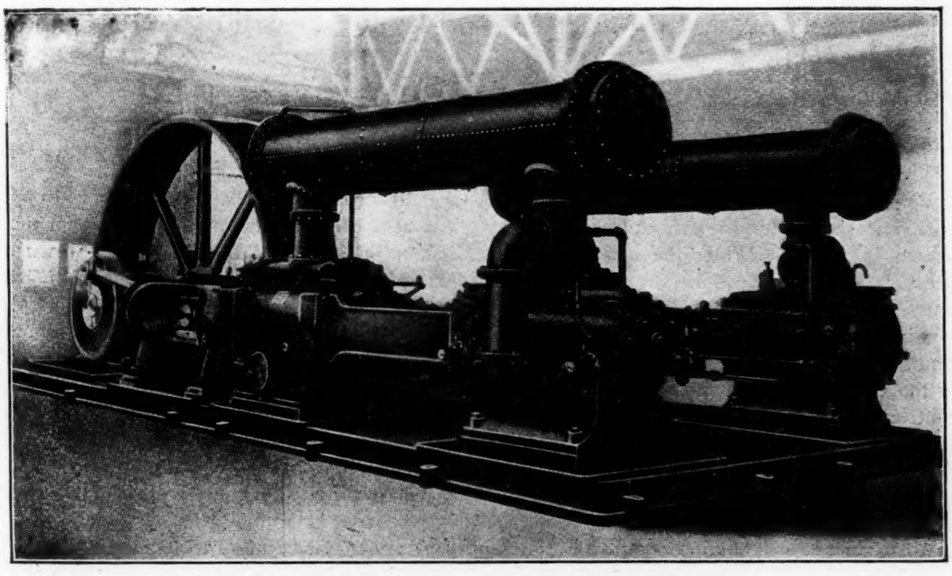


FIG. I. LARGE CANADIAN VARIABLE VOLUME AIR COMPRESSOR.

*Chief Engineer, Canadian Rand Company, Ltd.

tions per minute the velocity of the rim is 4,250 feet per minute and the calculated stress is 490 pounds per square inch in cast iron and 2,100 pounds per square inch in the steel bolts. It is hardly possible for a machine driven by an alternating-current motor to run much over its rated speed, but even at 41 per cent. higher speed, which would double the stresses, the wheel would still be absolutely safe.

VARYING AMOUNT OF AIR COMPRESSED.

Attention is called particularly to the method of unloading the air cylinders, so that the amount of air compressed will be varied to suit the requirements.

The inlet valves on both high-pressure and low-pressure cylinders are of the Corliss type with releasing gear but without dash pots, as shown in Fig. 2. When the piston is compressing air the valve does not release, but is opened by the eccentric a little after the beginning of the suction stroke (about 3 per cent., to allow for the expansion of the air in the clearance space), and closed by the eccentric at the end of the stroke. The action of the unloader is to admit air to the trip cylinder, shown in section, which pushes out the plunger, pushes down the trip cam, and releases the hook. The valve then remains open and the air blows freely in and out of the cylinder. The valve is prevented from moving too far when released by a stop on the outer valve bonnet. There are eight Corliss valves, and these are unloaded in pairs in the following order:

1st stage. Left-hand low-pressure front valve and left-hand high-pressure rear valve.

2d stage. Right-hand low-pressure front valve and right-hand high pressure rear valve.

3d stage. Left-hand low-pressure rear valve and left-hand high pressure front valve.

4th stage. Right-hand low-pressure rear valve and right-hand high-pressure front valve.

The diagram, Fig. 3, will make it plainer.

The first stage unloads 1, 1, the second stage 2, 2, the third stage 3, 3, and the fourth stage 4, 4. This gives the following variations of capacity: Full load, ¾ load, ½ load, ¼ load, no load. At whichever stage the machine is working the cylinder ratio is the same, and whatever air is being delivered is being compressed at full compound efficiency.

There are small weights inside the large weights arranged to be picked up or dropped one at a time, at each stage, so that not more than a quarter of the load will be thrown off or on at one time. Throwing on one-quarter of the load at a time does not produce any perceptible rush of current in an A. C. motor, while a large compressor in which the whole load is thrown on and off suddenly is apt to produce surges in the line. An advantage of this method of unloading is that at the same time that it reduces the power it also reduces the pressure on the journals; when the capacity is reduced to one-half, the load on the bearings is also reduced to one-half, and when there is no load on the cylinders there is no working load on the bearings.

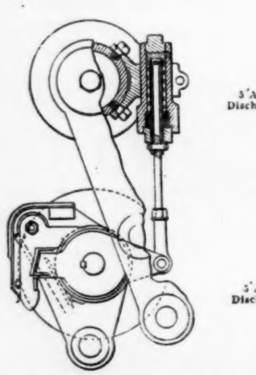


FIG. II. RELEASING GEAR.

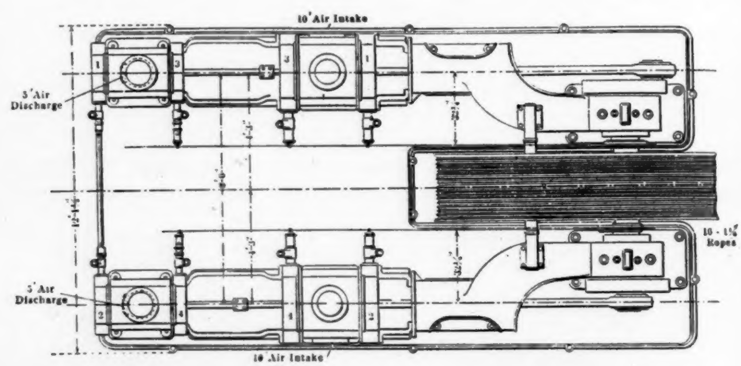


FIG. III. PLAN, SHOWING CUT-OUTS.

A summary of the good points of the duplex tandem compressor with four-stage unloader is as follows:

1. High efficiency of compression due to maintaining constant intercooler pressure and proper cylinder ratio.

2. Load is thrown on and off gradually, producing no disturbance in electric lines.

3. Reduces load on journals at part loads.

4. Delivers cooler air, thus also saving power.

5. Maximum demand for current varies approximately with the requirements for air.

over noon or night so that the machine may be unloaded before starting. By turning the three-way cock, air is admitted by the upper pipe to the exhaust ports of the unloader and from there to the trip cylinders, and releases all the Corliss valves so that they remain open and the machine starts up without load.

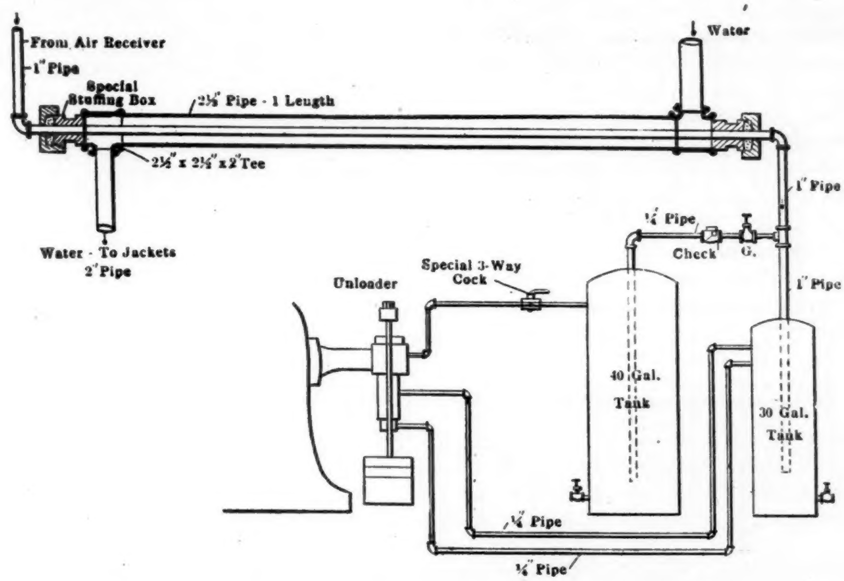


FIG. IV. FOUR-STAGE UNLOADER AIR SUPPLY.

AIR SUPPLY TO UNLOADER.

In order that the unloader may remain sensitive it is desirable that the air supplied to it should be clean, cool and dry. Fig. 4 shows an arrangement for this purpose and also a starting device. The air supply is taken from the main receiver (not shown) and passes through a length of water-jacketed pipe to cool it and condense the moisture. The moisture and any scale will collect in the 30-gallon tank shown. From the 30-gallon tank two pipes lead to the unloader, one to the bottom and one to the middle. The pipe to the bottom of the unloader raises the weights, while the pipe to the middle supplies the air which operates the trip cylinders. If these two pipes were combined in one, then the unloader would "hunt" or "dance" on account of the drop in pressure in the small pipe, caused by air being drawn off to operate the trip cylinders.

STARTING DEVICE.

The 40-gallon tank is intended to hold air

PRACTICAL COMPRESSED AIR REFRIGERATION

Discussing the practicability of a public refrigerating service with pipe-line distribution, Mr. Jos. H. Hart, in the *Engineering Magazine* speaks as follows of the possibilities of compressed air for the purpose:

Cold-air refrigeration by utilizing balanced expansion and obtaining cold air by the performance of work is not an efficient refrigerating process. It is used, however, to a very great extent in England, even in large units, and has been reasonably satisfactory. It is also used on shipboard and is in use in some special refrigeration systems in transportation for the conveyance of perishable products. Thus the method while not as efficient in individual units as a corresponding ammonia system, still is not so inadequate that it cannot compete under special local conditions. A compressed-air plant produces refrigeration when the air is used to do work, and in many

cases the exhaust from an air-driven engine will clog up with ice formed from the moisture present in the atmosphere. The compressed-air plant of Norwich, Conn., which supplies compressed air produced by a hydraulic air compressor to the entire town through a system of mains, has recently developed a machine for the production of liquid air from the exhaust of the average air-driven engine. Such a refrigerating system for pipe-line service would consist simply of a single line of pipe supplying compressed air at normal temperature. A small machine utilizing this air for work in the production of electric light for the dwelling or building could then turn its exhaust into a refrigerating chamber, and after that could allow it to escape into the atmosphere. Thus, such a system constructed on the above lines would be simplicity itself as far as the details of pipe-line construction and operation were concerned. The air pressure need not be great for mild refrigeration, and its advent is probably dependent only upon the development of a more efficient and satisfactory air compressor than the modern reciprocating type. The rotary air compressor will probably find a new field waiting as soon as it becomes an efficient practical machine.

VENTILATING THE GLUE ROOM

When hot weather comes, the disagreeable features of the glue room become more emphatic, and especially is there need for fresh air. At the same time it is just as imperative to keep drafts out of the glue room in summer as in winter. It won't chill the glue as quickly as cold winter drafts, but the trouble is, a current of air passing over an exposed surface that has been spread with glue, evaporates the surface moisture of the glue and forms a sort of a skim on it, so that it doesn't adhere well to the wood when put together. In summer it is not so much a question of temperature; in fact, the temperature is nearly enough right that little regard need be given this feature, but care must be exercised against currents of air passing over glue when it is freshly spread. Sometimes, when the gluing is not going on steadily, one can open up windows and doors until the air blows through freely for a while, and thus get some fresh air, and then the room may again be closed sufficiently to prevent currents of air when gluing begins again. This is not practical, however, where gluing is going on steadily, and it therefore becomes important to seek some means of ventilating for the comfort of those working in the glue room, that will not involve currents of air that do harm to the work.

Fortunately, we have made lots of progress along the line of ventilation, and there are various mechanical appliances offered for producing ventilation or a change of air in rooms every few minutes, without causing drafts. Ventilation of this kind has become quite a feature in the better class of hotels and public rooms of various kinds, and some of this idea in a modified form may be worked into the average glue room by a little attention to the subject. The main theory to work on is that of exhausting the air rather than blowing or permitting fresh air to blow in. Sometimes it can be done by ventilators at or near the top of the room; at other times it may call for light power-driven appliances. It is not sufficient to have vents open about the top of the room so that there is a current of air circulating through the top and no current through the bottom part of the room, because this doesn't in any great measure refresh those at work. What is wanted is a continual change of air in the work room—that is, throughout the room. This should be gotten, however, without producing currents, at least currents of such velocity as would rapidly evaporate the moisture from the surface of glued stock.—*Woodworker.*

A NOVEL TIMBER TESTING MACHINE

How is the strength of wood affected by repeated shocks? At the present time no satisfactory answer can be given. To fill the need for information on this important subject a special form of impact machine has been designed by the United States Forest Service to investigate the behavior of wood under repetitive loading. It is to be built at Seattle by the University of Washington, and is to form a part of the forest service timber testing station operated in co-operation with the university.

This machine will be provided with a 1,500 pound hammer which can be dropped upon the wood specimens under test from any height up to 3 feet. It is so constructed as to be both automatic and autographic. The record showing the behavior of the specimen under test is drawn on a long strip of paper which con-

stantly unwinds from one cylinder and rolls up on another. This record is drawn by means of a pencil attached to the hammer of the machine. When the machine is started the hammer is automatically raised to a height previously determined, when it falls on the specimen, and continues to be automatically raised and dropped until the machine is stopped.

From the results to be obtained from the tests made with this machine the forest service hopes to be able to devise more accurate and reliable methods for calculating the stresses which timbers used in bridges and other structures subject to repetitive loading have to stand.

[For operating the hammer, especially on account of the occasional and intermittent character of the work, of course compressed air should be used. Ed. *C. A.*]

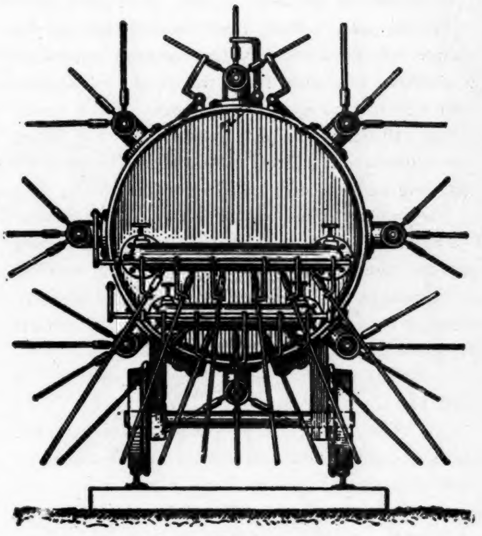


FIG. 2

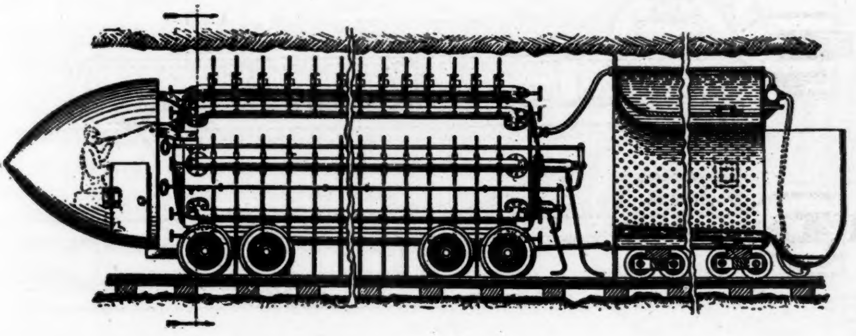


FIG. I.

A SPRAYING AND DUST LAYING DEVICE FOR COAL MINES

The following we condense from a paper by William Clifford in *Mines and Minerals*:

The researches of Sir Charles Lyell, Mr. Faraday, Mr. William Galloway, Sir Frederick Abel, and others led to the appointment of a Royal Commission to investigate the dust problem in England, and to the promulgation of the well-ascertained fact that the presence in the atmosphere of a mine of a quantity of firedamp too small to be detected by an ordinary safety lamp, by the addition of dust become explosive. There have been many accidents where the loss of life would have been small, if only firedamp had been ignited, but where dust acting like a train of gunpowder carried death and destruction into every corner of the workings—far beyond the reach of the flame which the initial local explosion of firedamp produced.

Many remedies have been suggested. The watering of the dust at points where blasting is done, and of main roads also was one remedial measure recommended and carried into practice. The watering of lengths of road so as to divide a mine into districts, each separated by a wetted zone, the lining of long lengths of road with smoothly plastered concrete and sweeping the same clear every day in order to attain the same isolation as was sought by watered lengths has been advocated by eminent engineers in their evidence before a British Royal Commission on Mining. In the North of England coal field the tiresome and laborious practice of brushing the dust from the walls of roads by hand, and filling the same into cars (tubs) now prevails to some extent, so serious a menace to safety is

considered the presence of this dust in a mine.

To do away with this dust difficulty the writer has devised a system and an apparatus to remove this dust from the points of deposition and to transport it by means of the ventilating current to points convenient for filling out, when accumulated in quantities beyond the carrying power of the air.

The general plan of operation is as follows:

(1) The diverting of the main ventilating current of a mine temporarily for the purpose of operating this dust-removal system and apparatus to a single district or road, by means of doors as shown in Figs. 3 and 4.

(2) The reversing of the air-current if need be.

(3) The fixing of permanent water-jacket tanks at points near the outlet of the mine, as seen in bypass roads in Figs. 3 and 4.

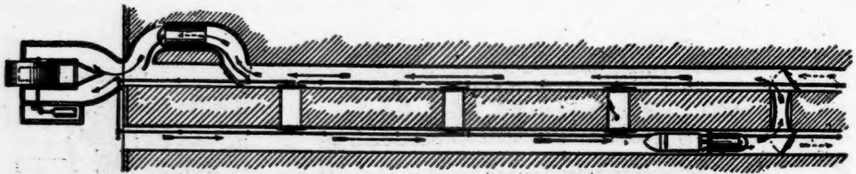


Fig. 3

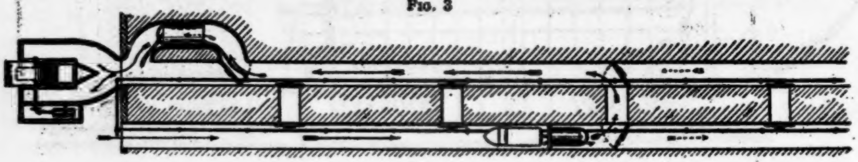


Fig. 4

(4) The deflecting of air from the central part of the road operated upon, to the sides, roof, and floor, thus greatly increasing its velocity, and hence its capacity to carry solid matter.

(5) The detachment of dust by means of jets of air striking the walls of mine, on every portion of their surfaces, and the carrying the detached dust forward, by the locally increased velocity of current, which the restriction of area of flow, by deflection to perimeter of roadway operated upon produces.

Fig. 1 shows a side view and Fig. 2 a front elevation of the machine which consists of a tank in which compressed air is stored. By means of the adjustable pipes shown, the air escaping from the tank may be directed in any desired direction so as to dislodge the dust. This dust is then carried through the orifice in the front part of the machine by the air and as the dust-laden air passes through this orifice it is sprayed by water forced out of the surrounding water-jacket by compressed air which is conveyed to the water-jacket from the air tank by a pipe as shown in Fig. 1. A considerable amount of the wetted dust will be entrapped in the hopper in the end of the machine.

The method of operating the machine is shown in Fig. 3 which represents a pair of headings forming the main passageway of the mine. The fan is working as an exhaust fan and the air travels in the direction shown by arrows. The machine is in the intake road, and it is assumed that it has traveled along the road driving the dust before it, and such dust as is not quenched in the water-jacket, is passing through the cross-cut shown immediately in front of the machine, into the return. A door with a regulator in it is closed across the main road in front of the machine. The regulator allows a small quantity of air to pass forward into the mine beyond, and return through a corresponding regulator in the return. A coarse wetted cloth covers the regulator in the intake. In the return airway near the fan is a bypass road with door to divert the air-current from the straight road through one of the fixed annular water-jackets with perforations in the interior wall. This annular jacket is fed from a regular source of supply under pressure, and the effluent water is carried away by the ordinary drains of the mine.

Fig. 4 represents the same things except that it is assumed that a panel only has been operated on in Fig. 3, and that this panel is now cut off by the closed door in front of the ma-

chine in Fig. 4, and the air passed into the return by another cut-through. In cases were the accumulated load of dust is too great for the velocity of air-current at command, the work is done in detail, panel by panel, or the machine run over the ground a second time.

This process is repeated until the whole of the lower road or intake has been swept clean. The machine is now usually detached from its water-jacket, taken into the return and a clean sweep is made from the point shown by the closed door in Fig. 3, to the mouth of the bypass road and its fixed water-jacket.

By thus using the apparatus alternately on the intake and on the return, the accumulated dust is driven through the water-jacket in the bypass road near the fan. As the pipes from the compressed-air apparatus are flexible they may be deflected forward so that the current from them will strike the upper part of the coal face. The long pipes near the floor can be raised so as to direct the currents against the coal face and the neighboring roof, while the bent pipes shown in Fig. 1 may be used to blow the dust from an undercutting.

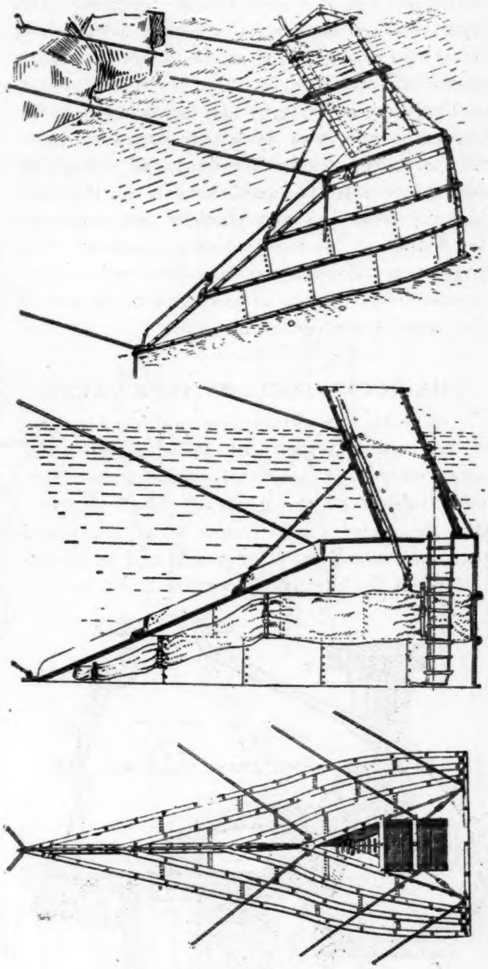
The use of this apparatus assumes a vigorous ventilating current or reserve power in the ventilation to produce it. In order to make the arrangement effective in new mines the main airways, both intake and return, should be such that the whole ventilating current can be passed through a single road or district.

CABBAGE—BEFORE AND AFTFR

When the United States consul at Marseilles wrote to the mayor of the city for permission to make investigations with regard to the disposal of garbage, sewage and other city waste, for his government, he was answered in this wise:

"Garbage is one of the finest dishes of the place. Well cooked and nicely prepared, as they do it in the country, it is something exquisite."

As an example of Gallicizing of the "American" language, this is a gem. As a hint to American sanitary officers, it is more. It is sublime. With its new garbage reduction plant and its splendid new sewers, St. Louis bids fair to soon dispose of its offensive refuse so effectively that the people of the city will be like the mayor of Marseilles, unable to distinguish between the thing, garbage, and another thing the name of which it resembles, cabbage, and in another quarter of a century may make the same reply if asked the same question.



MOVABLE CAISSON FOR RIVER MINING

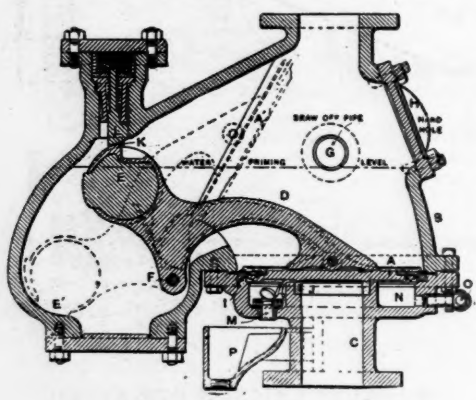
The recently patented device shown in the cut is to be used in rivers where the sand or gravel is rich in precious metal and where the flow of the water is so swift that it is impossible otherwise for workmen to hold their footing and work the pockets. The caisson is quickly movable from place to place and is held in place laterally by the guys shown, the water rising in the caisson to the same height as outside and the men working in the water with or without divers' suits according to the depth.

The caisson is made up of sections bolted together according to the height or capacity required, the point of the caisson facing the current the tendency of which is to make the structure hug the bottom more securely. An open tube or shaft is provided for workmen to enter, the top of sufficient height to be always above the water.

There is an air tight bag located within the caisson with a hose by which air under suitable pressure may be admitted and when this bag is distended to approximately fill the caisson the latter becomes buoyant and may then be floated to another working position. The bag when collapsed may be folded into a small compass and held by straps against the side of the caisson and out of the way.

THE ROCKWOOD DRY-PIPE VALVE

Automatic sprinkling systems for fire protection, which began with those in which the pipes were kept constantly filled with water, were subject to the generally fatal objection that the water would freeze in the pipes and the pipes would burst or would not be operative when the emergency occurred, and so dry-



RCOKWOOD DRY-P PE VALVE.

pipe systems take their place. The valve here shown in section, the invention of Mr. Geo. I. Rockwood, Worcester, Mass., and approved by the Underwriters' Laboratories, is an essential feature of such a system.

Besides the water supply with sufficient head an air pressure also is maintained to keep the system operative. The normal position of the moving parts is as shown in the cuts. Air under the required pressure constantly fills the large chamber, acting against the water pressure on the under surface of the main order. When the air pressure acting on the surface of the primary water is relieved by the opening of a sprinkler, the upward pressure of the water causes the valve plate to lift and an intermediate chamber fills with water, with the result that the entire force of the water exerted over the full area of the plate pushes it over to the wide open position and thus leaves a straight, unobstructed passage for the water to the system.

The lower part *C* of the valve body carries the air and water seats. The bronze valve plate *A* acts both to close the water inlet *J*, and to seal the air valve chamber by the contact of the rubber ring at its periphey with a black-tin air valve seat *I*. The valve plate and a counterweight *E* are attached to the swinging arm *D*, the whole swinging about the axis *F* as the valve opens to the position shown by the dotted lines. In the opening or closing of the valve the center of gravity is so changed that the valve will remain in either position.

The relative pressures of the air and the water must be maintained at a certain relation to each other within easily practical limits. With 50 lb. water pressure the limits of the air pressure are 15 and 25 lb.; at 75 lb. water pressure, 20 and 30 lb.; at 100 lb. water pressure, 25 and 35 lb., and so on.

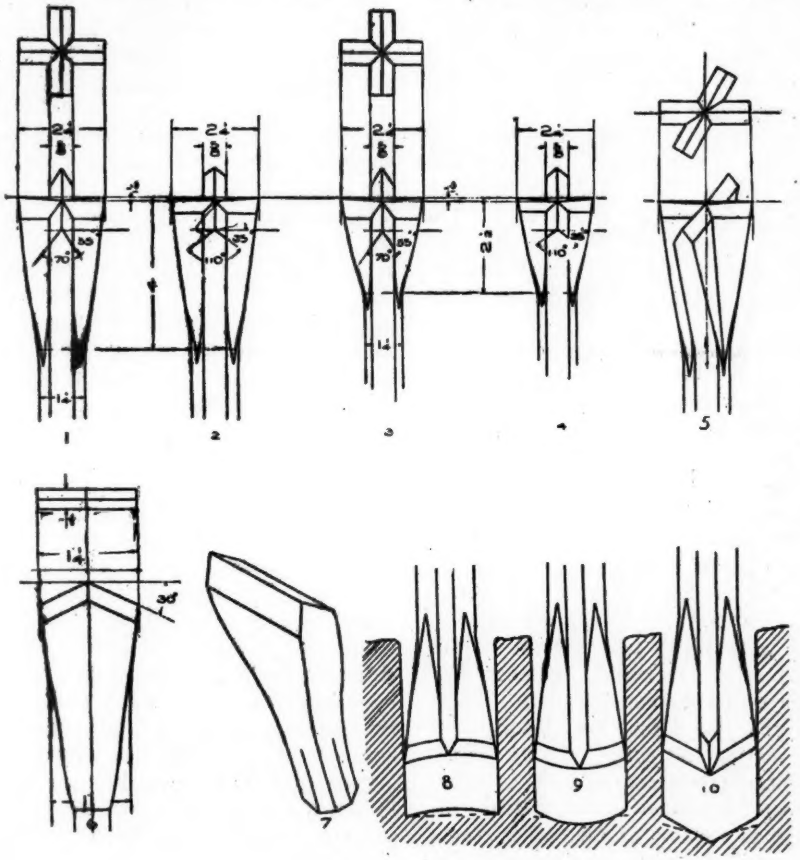
As a means of precaution the projection *K* on the counterweight is adopted to engage a spring catch *L* when the valve opens. This will prevent the valve plate returning to its seat if the combination occurs of a feeble water supply, a corroded or jammed spindle *F* and a reversal of flow after the riser has filled with water. The ball seated swing chick valve *M* is automatically held from its seat by the contact of its arm extension with the under side of the valve plate, and thus allows any water which may leak by *J* to run freely out of the intermediate chamber *N* into a drip cup outside. A drain valve for emptying the entire system of sprinklers is piped at *G*, and at *O* is a drip pipe for drawing the priming water left in the valve body when the system has been emptied.

After October 1 a letter weighing one ounce can be sent from any part of the United States to any part of Great Britain and Ireland, or vice versa, for two cents.

SHAPING, MAKING AND USING ROCK DRILL BITS

By D. J. O'Rourke.

The question of drill steel, its selection, care and use, is one which is given far too little attention, while in many cases it is the determining factor as to the economic success of a drilling plant. If the steels are of good material, carefully made, sharpened and tempered for the work to be done, and if fresh steels are put into use as soon as the gage begins to wear, the drills will come up to expectations as to speed and efficiency; but if the blacksmith is incompetent and the drill runner careless, the management could better afford to throw out its machines and go back to hand drilling.



ROCK DRILL BITS.

THE BLACKSMITH.

The blacksmith's work should be recognized as almost equal in importance to that of the master mechanic at a drilling plant. The best smith is none too good, even if there should not be enough work to justify the wages he may demand. It is cheaper to have a blacksmith and helper idle once in a while than to have two or three drill runners and their helpers standing around watching the drills wearing themselves to pieces, and perhaps helping them along with a sledge, while the drills fail to give results, merely because the bits are not right. There are also other men on the premises shoveling away dollars in the shape of coal, and all summed up, the idle time of the blacksmith and helper is an insignificant item.

When a new compressor plant is installed, every feature whereby a pound of coal or an extra foot of air may be saved or made is investigated, and every precaution is taken to

secure economical results. After the plant is running, the drilling is sometimes allowed to run along in such a way that anywhere from 10 to 50 per cent. of the power developed is lost. No one would think of allowing a hoisting engine to hoist a load with the brakes partially set, but something similar occurs when a rock-drill bit is run so long that it is the same gage for an inch or more back of its cutting edge, or is allowed to be made with shoulders on it in the first place.

SHAPE OF THE BIT.

For drilling rock of any kind, the cross-bit made like Figs. 1, 2, 3 and 4, sometimes modified to the X shape shown in Fig. 5, is usually employed. It will be observed that the bits above referred to are made concave, with the corners of the wings ahead of the center. This design is recommended because used bits show very little wear at the center as compared with their outer edges. This indicates that the corners do the largest part of the work. The cutting done by them so weakens the rock toward the center of the hole that it does not afford so much resistance to the center of the bit.

Figures 8, 9, and 10 show what actually takes place in fracturing the rock with bits of several shapes. Figure 8 shows the concave bit, whose corners cut ahead of the center, making the line of breakage very weak and leaving little resistance for the center of the bit, as described above. Figure 9 illustrates a convex bit. In this, the center has to cut ahead of the corners. The fracture line is thus divided, leaving but little work for the corners to do. The cross shape of the center, together with the increased amount of work which falls upon it, in this case, greatly retards its cutting efficiency. Figure 10, the diamond-pointed bit, also divides the fracture line, but at the same time increases its length, leaving less cutting for the center. With this bit, the rock tends to break to a flatter angle than the angle of the bit, allowing the center to go in advance of the corners for a few blows, when the entire bit again comes in contact with the rock, fracture again takes place, and the process described above is repeated. This bit is recommended only for marble, soft limestone, and other even, soft rocks. Its advantage for this work lies in the fact that nearly all drilling in quarries is done on laid-out lines, so that this form enables the holes to be started accurately. The bit, however, is made very thin and is not strong enough to be satisfactory on general mining and contract work. The flat, or "bull" bit, as it is sometimes called, shown by Fig. 7, is made in various shapes, but no matter how it is made its use is very severe on a rock drill. If thin, it has no reaming qualities; if made heavy, as it generally is, the blow delivered imparts a severe jar to the machine. The flat bit, with diamond point, Fig. 6, is a style which has been used in marble quarries from the earliest introduction of the rock drill. The steam pressure used in those days was considerably lower than now, so that this bit was satisfactory, and cut slow enough to ream the holes fairly well. Even under these conditions it was hard on the rotating device, but when higher pressures were introduced its cutting capacity was increased, while its reaming qualities remained the same. The flat bit may cut more rapidly for a short time, but in the long run the cross will be found more economical. The use of the X bit, Fig. 5, is not general, but sometimes is desirable when a cross-bit will persist in drilling "rifled" or five-fluted holes on rock of some kinds. Sometimes rifling is charged to the machine, but the fact that the X bit is not required on all kinds of rock rather disproves this imputation.

SHARPENING THE BITS.

Figures 1 and 2 are bits for hard, non-gritty rock, and are alike except for the different angles shown on the cutting edges. Figure 1 shows about the highest angle to which the cutting edge can be made without danger of breaking. The angle shown on the cutting edge in Fig. 2 is one of many which may be used under different conditions, without any change in the bit. In cutting hard and medium hard rock, sharp drills and a wide-open throttle may be used to good advantage, and the hole will not ordinarily clog with mud, as the amount of rock loosened by each blow is so little that it is at once mixed into slush by the water in the hole. The sharp rebound of the drill when striking hard rock, together with the positive recovery of the machine, quickly gets rid of this slush. If the same bits and drill are run on an open throttle in soft or even medium soft ground, the hole soon becomes clogged. The reason for this is that while the hole remains of the same diameter, and the amount of water for mudding purposes is therefore the same, the steel chips out three or

four times as much dust at each blow as it does in hard rock. The rate of cutting should therefore be reduced in order to keep the drill working at maximum efficiency. The speed may be regulated by throttling the air or steam but this reduces the rapidity of action of the drill, so that it does not always mix into slush the dust caused at even the slower speed. The recoil of the steel from soft rock is also considerably less. In soft rock duller bits should be used, like that shown in Fig. 4. The angle of the cutting edge may be even higher than this, sometimes almost square on the end, in order to secure good results.

LENGTH OF UPSET.

In connection with the above subject, it is well to bear in mind the length of the wings or ribs for different kinds of work. Figures 1 and 2 show an extreme length for very hard rock, intended to give strength and hold the gage as long as necessary. Figures 3 and 4 show shorter ribs which give the bit more clearance and make it more desirable for general purposes. Under ordinary conditions its ability to mix mud is much greater than that of the long bit like Fig. 1. This shortness gives greater flare to the wings, causing a greater backward thrust to be given the cuttings, whether wet or dry. In rock which wears the gage rapidly, however, the upset should be longer. For drilling dry holes in tunnel headings or elsewhere the bit with short ribs has less tendency to allow the hole to draw up. The friction of this style of bit retards the machine but little, and will cause it to cut down toward the lower side of the hole, thereby straightening it. If this is done in time, it saves frequent drops of the arm and keeps the hole where it is wanted. It will be found on experiment that such results cannot be gotten if a long bit with very slight clearance is used. The wings are five-eighths of an inch thick for the size shown in Figs. 1 to 4, and should never be less than that for this size of bit and steel. They should be the same thickness throughout to allow free return of the cuttings. If gage less than two and one-quarter inches is desired, make the bit correspondingly shorter.

GAGE.

It should be especially noted that in all the sketches the outer edges of the wings are square and not rounded to the circle. This feature is very important, to preserve the gage of the hole. Whether the bits are sharpened by machine or by hand, care should be taken that no bits are made with the outside edges made rounding. The question of maintaining the gage of the hole throughout its length is very important. It should be carefully determined just how much work each drill bit will do before the gage begins to wear. In the hardest rocks a bit is never in condition to use the second time, and from 24 ins. to 30 ins., depending on the length of the feed, is all that is ever attempted. Sufficient steel is therefore supplied, so that a sharp set is on hand for each hole. In softer rock and ore it frequently happens that the steel will not become dull even if used on several holes. Drill runners are, therefore, apt to disregard the question of the gage so long as the cutting edge is sharp. The gage, however, causes the rub in more than one sense. This is where the rub comes in that retards the work of the drills, shortens their life, consumes power, and increases the repair bills. For example, on this kind of rock a runner is given two sets of sharp steel to drill a required depth. Each set will drill perhaps two holes without making trouble. About the third hole on which this steel is used the bits stick and there is a constant demand for a hammer or a chuck wrench with which to beat the steel, and if the right point of humor is reached there is no discrimination shown between the steel and the drill piston. Here is a drill that worked all right on the first hole, fairly well on the second, and will not work at all on the third. The rock is the same and the drill is the same, but not so the bits. The only sharp bit that can be gotten into that hole must be made specially in the blacksmith shop half a mile away, so the hammering is kept up and the drill finally worked down somehow, taking usually more time than it took to put in the first two.

When the gage wears so that a new steel is needed in order to insure its following the last, an entirely new set should be used. It makes no difference if one of the bits still appears good, for it is economical not to waste time with it. On any rock on which the cutting edges are not dulled upon the first hole, a system should be devised by the foreman or superintendent to determine how much each bit will do without too much "hammer help." The improvement will be very pronounced.

The runner or blacksmith should have nothing to say as to this system. The blacksmith should have rigid instructions to furnish all bits to the exact gage required, so that the new bits will work freely when placed in the hole. Much time is wasted from the fact that bits are not made exactly to gage to begin with.

Users of mechanical drill sharpeners are advised to give thought and care to securing the proper dies and dollies to make bits suitable to the conditions under which they are to be used; also that when drills are being dollied the dies do not open. Some rather impossible-looking bits are occasionally seen for this cause alone.

TEMPER.

The matter of tempering bits is another point in which the blacksmith can save or waste much drilling time to his employers. A competent blacksmith will furnish bits of the precise temper, to suit the rock being drilled. —From *Mine and Quarry*, slightly condensed.

MODERN DEVELOPEMENT OF BLOW-PIPE PROCESSES

Blow-pipes may be classed according to the combustible material which they employ—hydrogen, acetylene, ordinary gas, and naphtha. All these utilize the same supporter of combustion, oxygen, which is usually supplied in flasks or tanks compressed to 150 atmospheres. It may be obtained by the electrolysis of water, by the distillation of liquid air, or by chemical reactions. The earlier forms of blow-pipe were operated with hydrogen obtained by electrolysis of water and stored in receptacles if prepared in advance, or in other cases generated at the point of use. Acetylene, employed in the second type, is obtained by the action of water upon calcium-carbide, and also may be generated in place or stored under pressure by taking advantage of its solution in acetone. It is not practicable to compress acetylene in reservoirs as may be done with hydrogen, because of its explosive qualities when compressed. MM. Claude and Hesse devised the acetone-solution method. The solution is stored in a flask filled with porous material, which forms a capillary tubular structure and prevents the spread of explosion.

The great advantage of blow-pipe brazing is that it is quite as applicable to mild steel as to iron, and that it permits the brazing of thin steel plates which were heretofore riveted or clinched together. The blow-pipe is further most valuable for use wherever it is necessary to work upon parts already in place. It comes into play particularly in the manufacture of metal tanks, various vessels made of enamel ware, feed-water heaters, etc., permitting the manufacture of forms of apparatus requiring numerous and complicated joints impossible to manufacture by forging. It has the further advantage of being a light apparatus, easily manipulated and requiring no elaborate installation.

At first sight it might appear that the melted or cast metal produced would not have the qualities of strength, and particularly of elasticity, shown by rolled or hammered material. Surprising results, however, are secured when care is taken during the process to avoid overheating or oxidation of the metal, or its alteration by the introduction of impurities such as sulphur or phosphorus. If, for example, we braze thin sheets or tubes of a few millimetres thickness and subject the brazed part to a light hammering or even a mild tempering, the metal will be found perfectly ductile and the joint will exhibit a strength almost equal to the resistance of the original metal. Tubes thus welded may be crushed or twisted, and plates may be bent and refolded, following the weld, without showing any cracks.

When it comes to the brazing of comparatively thick plates such as those of a boiler, the problem is more complicated because of the greater difficulty of producing uniform, thorough fusion to a thickness exceeding 6 or 8 millimetres. Under such conditions use is often made of an artifice which should be condemned, and which has to some extent discredited autogenous soldering of heavy plates. This artifice consists in chamfering both edges which are to be joined, and filling the space thus left by melting an iron wire in the blow-pipe flame. The procedure is not absolutely bad if it is very skilfully carried out, if the operator is careful to use a flame heating a large area and to let the drop of melted metal fall only on the part of the joint which has already been raised to the fusion temperature. It is easy to see what extreme attention is necessary to succeed in manipulation of this kind; if it is ill done, we get only poor adhesion; if it is well done, the relatively large quantity of melted metal introduced between

the two edges lowers the strength and destroys the ductility. Test pieces submitted to tension break without elongation.

A process of autogenous soldering which is employed with much success and which is particularly applicable to plates from 6 to 25 millimetres thick is the following:

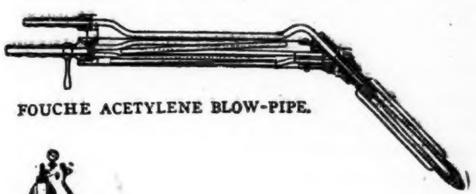
The two pieces to be joined are brought edge to edge without superposition, in perfect contact; if necessary to secure this they are first subjected to a light cut on the planer; they are then heated by means of two blow pipes, one above and one below, exactly opposite to one another, and producing as large a heated zone as possible. When fusion begins to appear on the surface it is safe to conclude that the interior of the sheet is at a white welding heat. The blow-pipes are then withdrawn and by a simple mechanical arrangement they are replaced by an anvil and a very light hammer not exceeding one or two kilogrammes weight. The blow of this hammer is sufficient to cause a consolidation of the metal along the two butting edges.

Perfect welding is secured and it is probable that the light hammering produces at the same time a certain orientation of the molecules favorable to the elastic properties of the metal In fact, if test pieces of metal so welded are tested under tension to the breaking point it is found that the grain of the fracture is not that characteristic of cast specimens, but is perfectly homogeneous, and like that of the original plate. The strength is but a small percentage less than the original and the elongation is satisfactory. Metal of a tensile strength of 36 to 38 kilogrammes and elongation of 25 to 28 per cent. shows after welding a tensile strength of 36 kilogrammes and elongation of 13 per cent. These results are completely satisfactory for the majority of cases in which it is desirable to substitute for riveting a process of soldering, secured rapidly and by simple appliances requiring no complicated or costly installation.

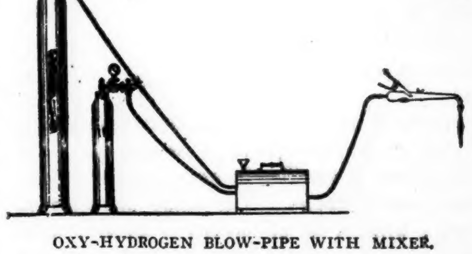
In all ordinary forms of blow-pipe there is of course one tube supplying combustible gas and another supplying the agent of combustion. The differences consist principally in the arrangement of these tubes and especially in their mode of connection. All present forms make use, under conditions which we shall examine further, of a mixture of gases effected in advance.

ACETYLENE BLOW-PIPE.

At first an ordinary form of blow-pipe was used for burning acetylene with oxygen. The two gases were kept separate up to the tip of the blow-pipe; that is to say, to the actual point of combustion. With acetylene, however, a serious inconvenience appeared; a heavy deposit of carbon took place, the flame was suppressed and indeed a sort of carbon mushroom resulted. It was therefore necessary to resort to some form of blow-pipe in which the mixture of gases might be made in the interior of the apparatus. But with acetylene a serious accident was to be feared, as the flame might flash back into the blow-pipe and cause an explosion. It is known, of course, that to prevent a back-draft of the flame the issuing gas must ordinarily have a velocity higher than that of the explosion wave, which for a mixture of oxygen and acetylene is extremely high. Practical experience showed that it was not necessary to attain this point because of the very small section of the blow-pipe tip. A velocity of flow equal to 150 metres a second is sufficient to prevent the flame



FOUCHE ACETYLENE BLOW-PIPE.



OXY-HYDROGEN BLOW-PIPE WITH MIXER.

from traveling back into the apparatus. In further prevention of this return of the flame the interior was filled with porus material, but this made it necessary to increase the pressure to the equivalent of 3 to 4 metres of water.

A problem still to be solved was that of utilizing acetylene not under pressure—that is, gas produced immediately in the works in calcium-carbide apparatus. M. Fouché found a very interesting solution by introducing the oxygen into the apparatus through an injector, which draws a flow of acetylene with it. The

acetylene enters through extremely small tubes which do not permit the passage of flame.

OXY-HYDROGEN BLOW-PIPE.

In this apparatus the two gases are always used under a pressure. The original form of hydrogen blow-pipe consists simply of a brazed sheet-steel receptacle terminating in a neck, upon which the blow-pipe tip is screwed. To the other end are brazed two attachments for the rubber tubing through which the gas flows from the reservoirs. Economy of combustion has been sought by preheating the gases. For this purpose they are made to pass through a coil surrounding the flame. This gives the regenerative blow-pipe. Lastly, in some important installations use has been made of a mixing blow-pipe. In this the blow-pipe itself is of the type already described, but it has a single attachment, for in this case the gases are mixed in advance.

It should be added that apparatus employing acetylene in solution and hydrogen in tanks is best suited for use in work requiring a portable installation and in establishments where continuous use of the process is not required; while it is more economical to use an installation with generators for acetylene and hydrogen where the work is to be continuous, or where the applications are many enough to allow continuous operation of the generating apparatus and are performed upon parts so light or so easily handled that they can readily be brought to the blow-pipe.

THE CUTTING OF METALS.

It is well-known that iron burns easily and rapidly in an atmosphere of oxygen gas. The experiment is familiar in every course in physics and chemistry. The same phenomenon occurs when a jet of oxygen is directed upon iron heated to a bright red—that is to say, the metal burns and the heat evolved fuses the oxide. The process for cutting plates by oxygen is based on these phenomena; it can readily be seen that it is possible to divide a piece of metal by means of an oxygen jet, but it is not easy in practice to attain a regular and clean cut.

At first use was made of an oxy-hydrogen blow-pipe to bring a certain portion of the work to a bright red heat. Then the flow of hydrogen was cut off and the current of pure oxygen was increased. A good combustion was produced, but it did not proceed very long. The resultant iron oxide not being hot enough, lacked fluidity; it was with difficulty removed, became mixed with the partially melted iron, and thus obstructed the close contact of the metal with the oxygen; the combustion stopped and it was necessary to bring the blow-pipe into play again. The manipulator, even after long practice, could obtain only an irregular cut, dirty, and with edges incrusted with closely-adhering oxide.

One of the engineers of a company in Brussels therefore devised a double apparatus which entirely remedies thes difficulties. This consists of two blow-pipes in one piece, which travel along the section to be cut. The first is an ordinary oxy-hydrogen blow-pipe which heats the metal to a bright red; the second directs a fine jet of pure oxygen upon the heated spot under a pressure varying with the thickness of the metal. The action of the two blowpipes is continuous; the first prepares the way for the second, furnishing a volume of heat sufficient to permit instantaneous combination of the oxygen with the metal in the heated zone. The metal is not melted, and the adjoining parts remain unaltered, as the action proceeds too rapidly for the heat to spread into the mass and the oxidized portion is removed by the pressure of the oxygen; the section is cleaner than a saw-cut and its width never exceeds 4 millimetres 1-16 in. The speed of travel of the double blow-pipe is about 20 centimetres (8 in.) a minute; in other words, the operation is quite rapid and comparable to hot sawing. The consumption of gas is relatively small, depending upon the thickness of the piece to be cut, and as the work is rapidly done the labor cost is not important.

The double blow-pipe, which is easily handled and furthermore may be guided by any sort of mechanical device, is available for cutting not only thick plates, but also, and with equal ease, tubes, beams, shafts, and all sorts of rolled sections. The cutting may be made to follow any line, executing all sorts of curves and profiles; further, it is not necessarily normal to the surface, the cut being easily made on a bevel. It is evident further that the quality or the mechanical properties of the metal do not in any way modify the process; whether it be hard or soft, tempered or annealed, chrome or Harveyized, the steel burns

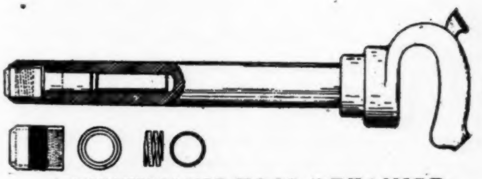
just as fast. The problem of cutting armor plates is thus fully solved.

The essential qualities of the process may be thus summarized: Extreme simplicity of the installation and appliances, complete mobility, independence of any need of motive power, absence of any reaction upon the tool, extraordinary speed of operation, and, so to speak, unlimited adaptability.

In illustration of the rapidity which above all characterizes oxyhydrogen cutting some examples may be adduced: An armor plate 160 millimetres (6.3 inches thick) was cut to a length of 1 metre in 10 minutes. A cut of similar length in a plate 15 millimetres thick took less than 5 minutes, and the cost of the operation did not exceed 1 franc 50 centimes.

To cut a manhole 300 by 400 millimetres (12 by 16 inches) in a plate 20 to 30 millimetres (.8 to 1.2 inches thick) requires 4 to 5 minutes. An opening 150 by 150 millimetres (6 by 6 inches) in a tube 5 millimetres thick, required 3 to 4 minutes, while the cutting of the same opening with tools would need from 35 to 40 minutes. The cost of this work by the oxygen method was from 12 to 15 centimes.

Another very striking example was furnished at the station of the Metropolitan Railway at the Place d'Italie in Paris. It was necessary to cut away an iron staircase 6 metres high whose width impeded the traffic. It was cut down to a width of 1 metre in four hours' time. At Bremen, Germany, also, the method has been used for breaking up ships and among other records the following time data are interesting; a plate 300 millimetres (12 inches) thick was cut for a length of 1 metre to a depth of 4 to 6 centimetres in 7 minutes. The same plate had been cut with a pneumatic chisel along the length of 1.15 metres and to a depth of 1.5 centimetres, but this work had required an hour. The oxygen method was used also for rivet cutting; in less than 12 seconds the head of a 22-millimetre rivet could be burned without any injury to the plates. The rivet was then driven out with a punch. The maximum thickness which has yet been cut is 210 millimetres (8.27 inches) in armor plate, but 300 millimetres has been reached in round shafting. Abstract of portion of paper by J. B. Van Brussel in *Engineering Magazine*.



A PNEUMATIC TOOL RETAINER

The cut shows the essential features of a retainer for pneumatic tools recently patented by Mr. E. J. Shoffner, foreman of the Norfolk & Western shops, Roanoke, Va. One of the inconveniences of the familiar pneumatic tool is that the tool itself is always ready to drop out when not in actual contact with the working surface. The present device holds the tool securely from dropping out while still permitting the necessary freedom of longitudinal movement. The cut shows a button set in place and the following from the patented specifications sufficiently describes the device:

"The combination of a pneumatic tool cylinder, having a reduced end, a retaining sleeve, having a chamber within it, the rear of said chamber being secured to the reduced end, said sleeve having an opening through its forward portion of lesser diameter than the inner bore of the chamber, a button set having a head of such length as to always project through the opening, the head being of lesser diameter than the bore, a shoulder on said head of greater diameter than the latter and of less diameter than the bore, a comprehensible element in the chamber of less length than the distance between the button set shoulder and the forward inner wall of the chamber, and a shank on the button set of less diameter than the head and shoulder, the shank projecting rearwardly into the tool cylinder."

The cap, or retaining sleeve, is knurled on the outside so that it can be easily unscrewed and removed for changing the tool

THE COMPRESSED AIR INJECTOR

In the Copper Queen mines, Bisbee, Arizona, the small ½-hp. electrically-driven ventilating blowers have recently been replaced by a new type of compressed-air blower, which is proving satisfactory. The principle upon which this new blower works is the same as that of an injector. A jet of compressed air passes first through a small nozzle, and then through three succeeding nozzles, each larger than the preceding one. This compressed air draws

in free air around the sides of the nozzles and the whole is discharged through an air-pipe into the face of a drift or the top of a raise. The compressed air is delivered to the blower through a ½-in. pipe. The first nozzle, which is made of brass with a steel casing inside to prevent injury, has an opening $^1/_{10}$ in. diam. The comparison, as worked out with a fair degree of accuracy in the Queen, between the electric blower and the compressed-air blower, is as follows: Discharging through 300 ft. of 6-in. pipe at the elevation of Bisbee (5,300 ft.), a 330-watt electric blower delivers 300 cu. ft. of air per minute. This is known as a ½-hp. blower. The 5-in. compressed-air blower with 95 lb. air-pressure, and a $^1/_{10}$-in. nozzle takes 19 cu. ft. of free air per minute, and delivers under the same conditions 380 cu. ft. of air per minute. The cost of steam to compress the air for the air blower is about four times as great as to generate the power for the electric blower, or running them both continuously the cost of power for the air-blower is about $6 per month more than for the electric. To offset this increased expense for power, about $6 per month is required for inspection, oils, and repairs on the electric blower, while these items amount to almost nothing on the new blower. The initial cost of the electric is more than three times as great as that of the air-blower. As a rule, the compressed-air pipes are in the drifts, carrying air for the machine drills, while often electric wiring has to be done especially for the electric blower. This would be more often true in the future, as the amount of underground electric lighting is being decreased. Often a small station has to be cut for the electric blower, while the other type can be put up wherever there is room for a 6-in. air-pipe. Another advantage is that increasing the length of the air-pipe, the amount of air delivered by the air-blower does not decrease as rapidly as with the electric, on account of less friction in the blower itself. This new blower is equipped so that it can be used for exhausting the bad air from the drifts instead of blowing in fresh air, and the efficiency ought to be nearly as great. For anything larger than a ½-hp. blower, the cost of compressing the air is prohibitive; the large electric blowers being only slightly more expensive to maintain than the smaller one.—*Mining and Scientific Press.*

A placard in front of a cheap show in New York announces that the interior is cooled with "artificial air."

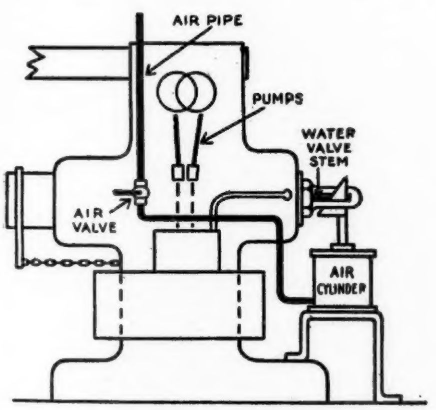
CONDITIONS OF AIR CYLINDER LUBRICATION

The fires which sometimes occur in air-compressor cylinders are due to the lubricating oil, the only combustible present. Inferior oils causes explosions by reason of the large amount of carbon and foreign substances they contain, but they are not the only oils responsible for these explosions. The conditions peculiar to a given machine may facilitate or retard combustion. For instance in a chemical works, a copper or coal mine, foreign substances in the atmosphere may furnish something to feed the fire caused by combustion of the residual carbon. Most oxidation in all cases takes place at the junction between cylinder and discharge pipe. Continual oxidation so reduces the size of the pipe that more air is compressed in the cylinder than can pass through the pipe. Increased friction and compression cause an abnormal degree of heat in the cylinder and trouble from fire is experienced. In all cases an oil should be used which causes the least oxidation possible, its flash-point being as high as consistent with good lubricating qualities. Ignition in the compressed air delivery pipe is not uncommon as shown by the explosion of two air receivers during the construction of the New York aqueduct; in one case the engine-room was destroyed by the resultant fire. The explosion was caused by the use of an oil of very low flash-point. This ignition has extended in some cases to the air receiver, and in one instance the flames were carried down into the mines by the compressed air. In some cases the pressure recorded by the gage has not been so high as that equivalent to the flash-point temperature of the oil. There must, however, have been an increase in temperature, and this is due to a momentary increase caused by the constricted air passages being choked by the deposited carbon. Trouble is increased by using too much oil, either of good or bad quality. This source of trouble is rather common, for many engineers have an idea that an air cylinder requires as much oil as a steam cylinder. Consequently deposition of carbon goes on at a very rapid rate. The carbon deposit can be removed by kerosene. Care should, however, be exercised in the use of that same, for its flashpoint is about 120 degs. F., and its careless introduction through the inlet valve has accounted for many explosions.—*Engineering Times,* London.

AIR VALVE ON HYDRAULIC WHEEL-PRESS

In the ordinary hydraulic wheel press as used in railroad shops and elsewhere the water which gives the pressure is controlled by a screw valve operated by a hand wheel, and when this valve is placed as usual at the end of the machine the operator is either compelled to walk to the valve every time or if he stands constantly by the valve another man has to look after and gage the wheels. The device here shown (the cut from Railway and Locomotive Engineering) was got up by Mr. J. J. Acker, car foreman of the Rock Island shops at Horton, Kansas.

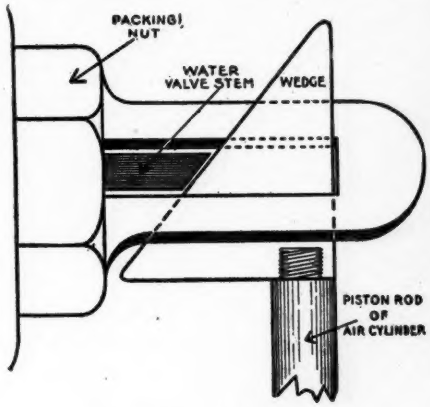
In this arrangement there is an air operated valve located where most convenient for the man in charge. For the familiar screw actuated water valve there is substituted a plain compression valve which normally is held closed by the pressure of air upon a piston. The stem of this valve projects out through a specially designed packing nut which has a projection ½ in. thick standing out from it in the form of a loop about 3 ins. long. Up and down in this loop a wedge-shape little crosshead is made to move by the operation of an upright air cylinder placed below it. This piece of mechanism is at the end of the wheel press,



AIR VALVE APPLIED TO PRESS.

der reaches it through a pipe so placed that the operating air valve is quite convenient for the man working the press.

When air is admitted to the cylinder its piston rises and the piston rod with the wedge-shaped crosshead goes up, the flat back of the wedge sliding along the outer end of the slot in the packing nut "loop." The wedge forces back the water valve stem and so closes the valve. When air is released from the upright cylinder its piston and rod descend, the wedge-crosshead comes down and the water pressure



DETAILS OF AIR VALVE.

opens the water valve. The water valve can be opened or closed very quickly and any degree of opening may be secured according to the movement of the wedge-cross-head.

This device, which is not patented, has had the effect of greatly increasing the output of the wheel press, as the little air piston works quickly in either direction.

OXYGEN PERCENTAGE AS AFFECTED BY MOISTURE

James Moir, in a communication to the Chemical and Metallurgical Society of South Africa calls attention to the errors which may occur in the readings of gas-volumetric apparatus on account of the varying percentages of moisture in the air. Speaking of conditions on the South African plateau where he writes, the altitude being about 4,000 feet, it would appear that on a warm day with the laboratory temperature at 72 degrees, Fahr., and the vapor pressure of water as high as 20 mm. of mercury (.787 in.) the error might be quite serious. This 20 mm. at the altitude mentioned corresponds to 3.23 per cent. of water-vapor in the air; consequently in analyzing air over water the oxygen percentage of the dry air is apparently depressed by 0.7 per cent.; while the difference (reported as nitrogen) is affected by two errors, namely, the above 0.7 per cent. and in addition the actual quantity of water-vapor present. Thus a sample of

air containing when dried 20.95 per cent. oxygen, 0.05 per cent. CO_2, and 79.0 per cent. nitrogen when introduced into an Orsat at 72 degrees F., will expand by 3.33 per cent.; and the analysis will give CO_2=0.05 per cent., O=20.25 per cent., residue=79.7 per cent. Seeing such an analysis, one would suppose that some of the oxygen had been used up, but in fact the apparent deficit is due entirely to dilution with water-vapor. Again, 3.2 per cent. of the residue is water-vapor, so that the true value of the inert gases (mainly nitrogen) in the saturated sample is 76.5 per cent.; the depression from 79.0 per cent. corresponding exactly with the dilution of the dry gas with 3.33 per cent. of water-vapor. Consequently, to get comparable results with such apparatus, it is necessary to recalculate the observed readings. It would be more correct theoretically to use in the calculation the actual percentage of water-vapor present at the time of sampling; but in practice it is usual to calculate back to dry air, so as to be able to compare directly with the existing standard analyses of fresh air. Thus if the observed readings are: CO_2=0.1, O_2=20.2, residue=79.7, and the temperature of the water is 70 degrees F., the barometer reading 620 mm., that is, vapor pressure=18.6 mm., then percentage of water-vapor is $(18.6/620)\times 100=3.0$ per cent. Consequently 100 c.c. of the wet gas contains CO_2=0.1 c.c., O_2=20.2 c. c., N_2, etc.=76.7 c.c., H_2O=30 c.c.; which quantities are also contained in 97 c.c. of the dry gas; therefore the true analysis of the dry gas is (multiplying the figure by $^{100}/_{97}$), CO_2=0.103 per cent., O_2=20.825 per cent., and N_2, etc.=79.072 per cent.

An example of such a fallacy is the deficiency of oxygen always observed in mine air. The atmosphere in mines is usually near saturation, and consequently dry air entering the downcast with, let us say, 21 per cent. oxygen, will through mere dilution with water-vapor contain only about 20.5 per cent. by the time it reaches the foot of the shaft. In spite of this elementary fact, many scientists have attributed the fall in oxygen to such things as the oxidation of pyrite or timber. It should also be noted that the state of humidity of the air also affects the results of CO_2 determinations by Pettenkofer's method, but only to a slight extent. The observed barometric pressure should be diminished by the existing vapor tension at the time of sampling.

THE FAN BLOWER IN INDUSTRIAL HYGIENE

The report of the Massachusetts State Board of Health gives large space to the general topic of ventilation, and especially in presenting evidence of the easy possibility of vastly improving conditions by the employment of suitable apparatus. When dust or fumes are formed in industrial operations they may be assumed to be always injurious and often dangerous, and they should be systematically taken care of.

The fan blower is shown to be the one reliable device for this purpose. Its positive and controllable action makes it applicable to all conditions, and the ready means of rendering practically harmless many occupations which are otherwise exceedingly unhealthy. It is primarily essential that the fan be locally applied, that is, that the source of dust or fumes be so hooded and connected with the fan that whatever is objectionable may be immediately drawn away, and not allowed to escape into the room.

In each industry there are applications peculiar to its own processes, but the general public has little knowledge of the methods employed. Perhaps the most familiar application of the fan for the handling of refuse and the removal of dust is in the planing mill where each machine is hooded, and such a vacuum is produced in the connecting pipes that the fan is enabled to convey the waste material throughout long distances, pass it through dust collectors, and allow the clarified air to escape to the atmosphere, while the shavings and sawdust are as quietly deposited as may be desired.

In the shoeshop the fan is almost universally employed to remove the fine leather dust from the buffing wheels and other shoe-working machines. Here close hooding is necessary to economize the volume of air handled by the fan.

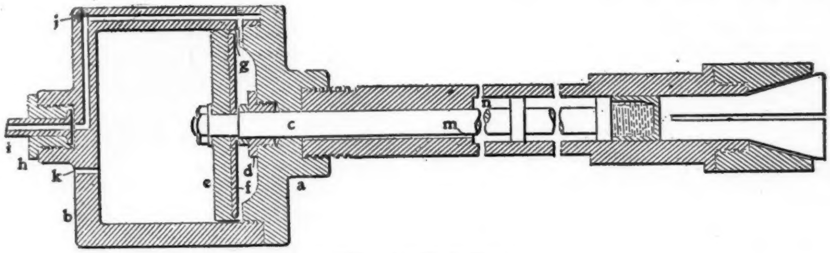
In the manufacture of derby and felt hats the essential material is fur heated with cyanide of mercury. Separation of coarse from fine hair is accomplished under the action of powerful suction.

Mechanically operated exhaust systems find helpful applications in connection with machines for pointing the pins of horn and celluloid combs, the "dusters" used for cleaning paper mill rags, the hydroflouric acid tanks of the glass cutter, the polishing lathes used by the manufacturer of optical lenses, and in the ma-

chine shop, the textile mill, the match factory, the lead works, and a hundred other industries.

In a system applied to a series of brass grinding and polishing wheels, each hood is so constructed that by means of the swinging side plate the wheel may be readily replaced. Visors at top and bottom of the hood may be adjusted so as to include any desired portion of the wheel. The lighter dust is carried away by the air passing through the fan, but the heavier metallic particles fall into a hopper below, whence they can be periodically removed.

There is manifestly no limit to the variety of applications of the fan blower which may be made to improve hygienic conditions. It is perfectly evident that the objectionable features obtaining in most industries may be thereby removed, or their influence may be reduced very much, with a material result in the healthfulness of employees.



A PNEUMATIC CHUCK.

A PNEUMATIC CHUCK

The cut herewith, from the *American Machinist,* shows a pneumatic chuck for use on monitor lathes in place of the usual lever used to operate draw-in checks. It may be used on castings or any work that does not require an open spindle. One with a 5½-inch bore, used at 75 pounds air pressure, will be found large enough for average size work in brass. This size is strong enough for the use of a 2-inch pipe tap.

Referring to the sketch, which shows it on a lathe spindle connected up, the cast-iron body *a* is threaded to screw on the end of the spindle. The other side is threaded for the cast-iron cap *b,* which should be bored accurate and highly polished. The body is bored a sliding fit for the draw rod *c* and bored and threaded for the nut *d.* This chamber and the end of the nut should be tapered, on the face, as in sketch and used as a packing box, preventing the escape of air into the spindle.

The piston consists of the cast-iron plates *e* and *f* with the leather cup disk *g* between them. The plate *e* should be a loose sliding fit, the leather disk serving as the air check. The end of the cap is bored and threaded for the nut *h* which is bored, and the end tapered and fitted with the brass nipple *i,* the taper of which is ground to the nut; *j* is the air passage drilled through from the outside, running from the nipple chamber to the body bringing the air back of the piston. The holes in the outside are plugged with small studs screwed in; at *k* is a small hole to allow the air to escape as the piston moves. The drawing rod *c* is fitted in the spindle as usual in this style of machine, with the key *m* fitting the keyway inside of the spindle, and a coil spring at *n,* to draw back the rod when the air is released.

The short brass nipple *i,* is fitted to a union and the air pipe which can run down in front of the machine and at a convenient position the cut-off cock may be inserted. A plug cock with a waste hole drilled in one side through both body and key may be used. This waste hole is to allow the compressed air to escape from the cylinder as the cock is turned off.

TUNNEL DRIVING AT LOW COST

By Walter H. Bunce.

The driving of the Chipeta adit at Ouray, Colorado, was not especially notable as an important operation, but on account of the rapid driving and the resultant low costs, attention was attracted to it. The adit was projected as a working entry to simplify the mining of the American-Nettie quartzite stratum, which had faulted downward. The old entries were tortuous inclines terminating at the fault. The portal is in the face of the steep mountain forming one wall of the canyon north of the town of Ouray, at an altitude of nearly 9,000 ft. and 1,700 ft. above the bed of the river. For economic reasons the power-plant was placed at the river and a line of 3½ in. standard pipe

was laid on the surface to carry compressed air to the adit. This pipe-line, 3,400 ft. long, has given no trouble in summer or winter.

During the installation of the plant and pipe-line, work was carried on by hand-labor, the adit reaching a length of 263 ft., including the portal section of 115 ft., which was heavily timbered 7 by 7 ft. in the clear. Machine-drilling was then started and a run, which lasted for five full months, was made, only two rounds of holes being lost in that period.

This run of five months (152 days) resulted in driving the heading 7½ by 7½ ft. in the clear, a distance of 1,712½ ft. in hard rock; a monthly average of 342½ ft. The best weekly record was 85 ft.; the best month (31 days) was 359 ft. But two 8-hour shifts per day were employed. Compressed air at about 100 lb. was supplied to a pair of 3 1-8 in. New Ingersoll drills, both mounted on one single-screw column set horizontally above the muckpile. The round, consisting of from 15 to 19 holes, was drilled—except the lifters—from this setting, the bar being re-set for the lifters after the muck was away. The 'cut' was taken from the bottom, uniformly. Three drill-men tended the two machines, drilling a full round each shift.

An unusual system of 'mucking' was employed, which, perhaps more than any other one thing, may account for the substantial rate of progress. The tunnel track, 18-in. gauge, was carried close to one side of the adit, and a floor consisting of steel plates and planks was maintained with the greatest care for not less than 60 ft. back from the heading. This floor was moved forward every round. No switches or turnouts were used; cars measuring 20 cu. ft. capacity were specially designed and these, although weighing empty 1,000 lb. apiece, were so perfectly balanced that the empty cars composing an incoming train were easily 'jumped' off the track on to this floor, the loaded cars passed by, and then the empties replaced on the track in detail as required by the muckers for loading. Muck was handled with No. 6 square-pointed shovels. Four shovelers and a mule-driver composed each shift. Track was laid and leveled by the muckers. Each shift, composed of drill-men and muckers, started work together. No ventilating system was installed, the smoke being blown back with air from the compressor. The adit throughout its entire length was perfectly dry.

This adit was an independent operation, the employees having no other occupation, so that their total wages are a charge against the work. Their wages were: Foreman, $5; drill men and blacksmith, $4; blacksmith-helper, $3.50; muckers, $3; compressor-engineers, $3.50 per 8-hour shift. No bonuses were paid except on Christmas day, when double time was given. The following costs are computed from March 1, when 1,835 ft. (including the portal section) had been completed, and embrace every item outside of construction and equipment accounts, which were closed before the current accounts were opened. The 'Power' account covers labor, coal, oil, and lights, everything at the compressor station; 'Labor' covers all other labor except that charged into 'Lumber and Timbers.' 'Tunnel Expense' covers tool-renewals and repairs, blacksmith's sundries, forage, oils, and general sundries at tunnel; 'Track and Pipe' covers cost and transportation of rail, fittings, ties, pipe, and pipe fittings; 'Expense' covers city office, rent, furniture, and incidental expenses. The compensation of the acting superintendent is nowhere included in the costs as shown.

Distribution of costs.	Total.	Cost per foot.
Tunnel expense	$556.94	$0.303
Track and pipe	1,532.26	0.835
Power	2,862.71	1.560
Lumber and timber	533.51	0.291
Labor	11,981.85	6.529
Lights	233.70	0.127
Explosives	3,522.06	1.919
Expense	836.11	0.455
(1835)	$22,059.14	$12.02

Pipe-line through tunnel is 3½-in. standard black pipe. Track is 16-lb. section, on ties laid 20 in. apart. Powder (40 per cent. dynamite) cost $0.1315 at the portal. Close estimation places its consumption at 14.5 lb. per foot for machine-driving. Steam coal cost $3 per ton at the boilers. The air-pressure was nominally 100 lb. and a recording gauge kept on the line proved of value in many ways. There was always plenty of air. No charge for depreciation of tools and equipment has yet been entered; renewals and repairs are made and charged currently to 'Tunnel Expense' and the actual value of the outfit to the company is about equivalent to new, as nothing has been allowed to run down.—*Mining and Scientific Press,* San Francisco.

DIFFERENT POWER COSTS FOR STEAM DRIVEN COMPRESSORS

Chas. D. Havenstrite, in a series of papers recently current in the Cold Storage and Ice Trade Journal discussing in detail the several features of the refrigerating machine calls attention to the different possible rates of steam and coal consumption in operating the compressor, the most responsible portion of the apparatus. As the matter is entirely pertinent to steam actuated air compressors for whatever purposes employed, and as it enforces a lesson not yet fully learned, this portion of the paper is here reproduced and is commended to the attention of all who should be interested.

There are three usual types of steam engines employed for air compressors: the simple slide valve, simple "Corliss" and the compound condensing "Corliss" engine. The steam used by these will be about as follows:

Simple slide valve, 60 lbs. of steam per H. P. hour.

Simple "Corliss," 26 lbs. of steam per H. P. hour.

Compound condensing "Corliss," 18 lbs. of steam per H. P. hour.

In order to compare what the fuel consumption of each of the above will be, we will consider a 25-ton refrigerating machine. Allowing 1¼ H. P. per ton of refrigeration, a 25-ton refrigerating machine will require a 31¼ H. P. engine. Each 25-ton machine will then use the following pounds of steam per hour:

Simple slide valve, 1,860 lbs. of steam per hour.

Simple "Corliss," 806 lbs. of steam per hour.

Compound condensing "Corliss," 478 lbs. of steam per hour.

Assuming an evaporation in the boiler of 7 lbs. of water per pound of coal, which is average, we have:

Simple slide valve, 266 lbs. of coal per hour.

Simple "Corliss," 115 lbs. of coal per hour.

Compound condensing "Corliss," 68 lbs. of coal per hour.

And for 24 hours operation:

Simple slide valve, 6,384 lbs. of coal per 24 hours.

Simple "Corliss," 2,760 lbs. of coal per 24 hours.

Compound condensing "Corliss," 1,632 lbs. of coal per 24 hours.

It is thus evident that there is quite a difference in the fuel consumption of the three types of steam engines and it is also evident that each machine will require a different size boiler to operate it. Thus a boiler just large enough to operate a simple "Corliss" engine will operate a compound condensing "Corliss" engine with ease and good boiler economy in addition, while it would be totally unable to operate a slide valve engine of the same horsepower.

It is not usual practice to use a "Corliss" engine on machines under 15 to 25 tons refrigerating capacity, as a "Corliss" of such small horse-power becomes more or less troublesome. Further, machines of such small size are not always run by skilled men and it is therefore better to furnish the simplest type of engine. But with the larger sizes it is well to consider whether a simple or compound condensing "Corliss" engine is to be used, as the difference in fuel consumption becomes quite large and usually warrants the higher cost for the more economical of the two.

HYDRO-OXYGEN METAL CUTTING

Oskar Kylin, of the editorial staff of *Machinery* is visiting shops in Europe and sends readable and interesting notes of things seen there. The following from the Borsig Works, at Tegel, near Berlin, puts us in closer touch with the actual operation of cutting metals by burning. He says:

As is well known, the principle involved in this method of cutting iron is the use of the oxidizing effect on the metal, or, in other words, the actual burning of the iron. In order to cause rapid combustion of the iron when the oxygen is applied to it, it must be heated to a temperature of 1,300 to 1,500 degrees F. before applying the oxygen. This pre-heating of the iron is accomplished by a burning jet of hydrogen and oxygen. The apparatus for cutting the iron consists of two nozzles, arranged to follow each other, the first nozzle pre-heating the iron, and followed by the second nozzle for the application of the oxygen, this causing combustion of the iron, and executing the cutting. The two nozzles are arrange so that the oxygen will always strike exactly the same spot which has been pre-heated by the preceding flame.

It is important that the cutting nozzles be moved at a certain correct speed. If the cutting nozzles are moved too slowly, the contin-

uous cutting will be interrupted, because the iron will get time to cool off before being struck by the stream of oxygen from the second jet. If, again, the nozzles are moved too quickly, the oxidizing effect will not be complete, and the cutting will not reach through the piece to be cut. With some practice, however, it is not difficult to learn by experience the correct speed for any particular work. When properly done, a cut made by this method is very smooth and equals a sheared cut.

It might be assumed that the material would be severely attacked on the surface by the influence of the oxygen, but this, however, is claimed not to be the case. With the exception of a layer of 0.01 inch, at the most, next to the cutting edge, the material keeps its original chemical composition, and the physical qualities remain the same. It is claimed that pieces of iron up to a thickness of twelve inches may be cut by this process. Of course, the exactness of the cut changes with the different thicknesses. At a thickness up to 2 inches, the process may be carried out within limits of 3-64 inch, while at thicknesses of from 2 to 4 inches, the limit attainable is 3-32 inch, and above 4 inches it is still larger. The width of the cut, of course, also increases with the thickness of the material.

The blow-pipes are connected with flexible piping to the tanks filled with the respective gases. As the pressure in the tanks is high, being about 150 atmospheres when filled, the gas passes through a pressure reducing valve before being used. The pressure of the oxygen, when used for cutting, varies, depending upon the thickness of the material, from about 1½ to 5 atmospheres.

As a matter of curiosity, some work done by the assistance of the hydro-oxygen jet may be mentioned; when visiting the Deutsche Oxhydric Co., the writer saw a large bunch of grapes with leaves and branch of the vine, which, by the aid of the hydro-oxygen flame had been made from ordinary thin sheet iron. The imitation was good and, although the piece was of iron, it was very light. There was also a branch of a pear tree, with a large nice-looking pear, and two leaves, and also a lily of the valley made in the same way. As a souvenir, the writer received a cup made, during his visit, from welded pipe, by the aid of the same process. The pipe was chucked in a lathe and then heated by the gas jet, and at the same time pressed to shape by hand by a plane tool.

REGULATING HUMIDITY IN FACTORIES

The control of humidity of air rendered possible by the air-washing system was well shown in a series of tests recently made at a cotton mill in Belmont, N. C., in which there is installed an air-washing equipment in connection with a hot-blast heating system having a fan of 25,000 cu. ft. capacity per minute. The mill is a two-story building with 5,000 spindles and a cubical content of about 170,000 cu. ft. per floor. Two tests were recently made with the system, one with the humidity at a very low point, one of the dryest days of the month, and the other at a time when the humidity was exceedingly high. On the first test the outside air ranged between 9.30 a. m. and 3 p. m., from 44 degrees to 52 degrees, dry bulb, from 36 degrees to forty degrees, wet bulb, and from 40 to 30½ per cent. humidity, but the air left the air washer at a humidity of from 96 to 97 per cent. and that in the card room was held at about 61½ per cent., in the spinning room 69½ per cent. and 83 per cent. in the winding room. In the second test, the outside temperature was constant at 48 degrees, dry bulb, and 47 degrees, wet bulb, and 95 per cent. humidity, and the air leaving the humidifier had a humidity of 96½ per cent. The humidities thus secured within the mill were 64 per cent. in the card room, 70 per cent. in the spinning room and 87 per cent. in the winding room. The air washing and humidifying equipment was installed by the Buffalo Forge Co.

UNWELCOME AIR BLASTS

The Quincy, one of the oldest and most extensive of the mines in the Michigan copper group, is troubled by air blasts caused by the falling and settling of rock in the many miles of abandoned workings. The falling rock causes compression of the air in other parts of the mine, and sometimes the shock of the fall and the compression is sufficient to cause a miniature earthquake which may be felt for several miles around. The distturbance comes without warning, at times killing or injuring the workmen.

COMPRESSED AIR

AND EVERYTHING PNEUMATIC

Established 1896

W. L. SAUNDERS, - - - - - - Editor
FRANK RICHARDS, - - Managing Editor
L. I. WIGHTMAN, - - - Business Manager
H. L. KEELY, - - - - - Circulation Manager

PUBLISHED BY THE

Compressed Air Magazine Company
Easton, Pa.

New York Office—Bowling Green Building.
London Office—114 Queen Victoria Street.

Subscription, including postage, United States and Mexico, $1.00 a year. Canada and abroad, $1.50 a year. Single copies, 10 cents.
Those who fail to receive papers promptly will please notify us at once.
Advertising rates furnished on application.

We invite correspondence from engineers, contractors, inventors and others interested in compressed air.

Entered as second-class matter at the Easton, Pa., Post Office.

Vol. XIII. SEPTEMBER, 1908. No. 9

CONTENTS

UNDER-GROUND WATER SUPPLY FOR CITIES

The safest, best and cheapest water is secured under ground; if obtained in gravel with a reasonable overlay of clay or from the rock itself, there is little chance for any contamination. Sand stone or lime rock wells produce the purest and best water that can be obtained. Shale sometimes produces water that has a peculiar odor and taste that is objectionable, and frequently shale water is salty. In most localities rock water is secured within two or three hundred feet of the surface of the ground; in a few exceptional cases it has been found necessary to go down 1,500 to 2,000 feet. A great many of the wells in Chicago are 1,600 feet and pumped with compressed air. Whatever the depth may be, this is the surest, safest and cheapest method for producing water, and it is a rare instance when water can not be obtained by drilled wells. Some cities get their water supply from rivers or lakes and filter it. This is only, however, when the underground water is found to be salty or contain such chemical properties as render it objectionable. When preparing to secure water for towns or villages, the first course to pursue is the preliminary prospecting to find the best and most available supply. Small holes can be used, usually from 5 to 6 inches, as water can be tested for quality and quantity in this size hole and the expense of drilling them is not so great as is the case with a larger size. The prospecting should cover a large area, and it frequently happens that more water supply is found within a radius of half a mile or frequently a good supply is found in the gravel and also in the rock below. After locating what appears to be a good supply, samples should be taken and submitted to the state board of health, or some other reliable laboratory, where they are equipped to make a reliable analysis. After it has been determined that the quality is good, the water can be tested for quantity by any of the well known methods.

THE DRY AIR BLAST IN THE BESSEMER CONVERTER

The Gayley dry-air blast system having been used with such marked success in several blast furnaces in the last two or three years, arrangements were recently made at the South Chicago works of the Illinois Steel Company to try the effect of the dry blast in the bessem-

er converter also. A run of two days was made, the average reduction of moisture in the air blown into the converters being from 5.98 to 1.39 grains of moisture per cubic foot.

The results obtained were remarkable, and may mark an epoch in steel manufacture. Throughout the test a better and more nearly uniform grade of steel was produced. The ingots cast were more solid, free from blow holes, except at the extreme top, and the blooms made from them showed unusual solidity and freedom from segregation. With the usual discard, the blooms were used in rolling 100 lb. section rail, and in the tests only 1 per cent. of the rails, a very unusual proportion, were rejected as defective or of second quality. The results obtained were further encouraging in the direction of increased capacity for carrying scrap and other items bearing on cost, and in the enlarged control of high or low silicon irons.

The test spoken of was on such a scale and so carefully made that it would seem to fully confirm Mr. Gayley's claims for the advantages of using dry air in the converter as well as in the blast furnace. It may be of great importance in restoring confidence in the bessemer process, and in putting the converters again on a parity with the open hearth furnaces as far as the quality of the product is concerned.

This application may contribute largely to the solution of the steel rail question which has been so insistent of late. With similar results to be depended on in continuous operation there will be no longer necessity of abandoning the bessemer converter and adopting the open hearth furnace for rail material.

INCIDENTAL LESSONS IN ROCK DRILL TESTS

At the June meeting of the South African Association of Engineers Mr. E. J. Laschinger gave some interesting particulars of tests which had been made at the Meyer & Charlton mine with the New Ingersoll and the Konomax drills, the latter a local production. The chief results of the tests were:

(1) It was proved that the ordinary 1-in. pipe and 1-in. air hose were not of sufficient capacity to serve 3¼-in. drills satisfactorily. (2) The necessity of renewing the pistons, valves, and other accessories of the rock drills more frequently than is the present practice was apparent from the higher results achieved by new drills as compared with those which had been runing for some time. (3) Contrary to the general opinion, it was found that the loss of pressure from leakage underground (and it must be stated that the Meyer & Charlton is an old mine, and the connections have been established for years) was less than 5 per cent.

There are a number of experiments being conducted on these fields in connection with rock drills, with a view of determining the most economical pressures and other matters which concern the effective power of the drills. These experiments are welcomed by the mines, as they all tend in the direction of increased efficiency.

REMOVING IRON FROM WATER BY AERATION

Dover, N. H., obtains its water supply from several springs located in low ground, just below a sandy ridge, the water being collected in 2,000 feet of 10-inch vitrified sewer pipe laid with open joints from 10 to 12 feet below the surface. The water from some of the springs contains a considerable amount of iron, sufficient to make it undesirable for washing white clothes in, and those springs were cut out from the supply for some years. It was later decided to use this water and endeavor to remove the iron from it as far as possible. The ordinary method of accomplishing this is by aeration, which renders the iron insoluble, followed by removal of the precipitant by filtration. Under the advice and direction of William S. Johnson as consulting engineer, the apparatus described herewith was built, as a temporary affair only.

The sod and loam were removed from a plot of ground about 400 by 150 feet, situated 400 feet above the springs from which the acceptable water was obtained, thus exposing a sandy soil, whose elevation was 27 feet higher than the vitrified collecting pipe-line. The iron-bearing water was pumped to the filter bed through 400 feet of 4-inch pipe, which, at the bed, was connected to two lines of 2½-inch pipe, in the top of which were drilled ⅛-inch holes in four lines. The pressure from the pump forced the water through these about 10 feet into the air, and as it fell onto the sand bed in the form of spray it absorbed the desired oxygen. Passing down through the way to the springs which were being utilized, sand, the water was filtered and found its and from them to the collecting line.

The superintendent states that they undoubtedly lose a part of the water which is pumped but analyses appear to indicate that 95 per cent. of the iron has been removed from that collected, and the plant may, therefore, be said to be to this extent a success. *Municipal Journal.*

AN AIR JET HELPS THE LOADING

In excavating for the foundations for the Hudson Terminal Buildings there was a great mass of material to be handled, much of it consisting of stiff wet clay and quicksand. This material was first loaded into a bucket which was hoisted close up to a traveler suspended under an I beam and then run over a hopper where it was dumped. Wagons would then come in succession under the hopper and each take its load. The water from the quicksand puddled the clay and compacted it so solidly at the bottom of the hopper that when the sliding door was opened to let the load down into the wagon the clay arched itself so that it would not slip by gravity and it was necessary to keep three to four men on a platform over the hopper to cut the material and free it with heavy slice bars. It took about 10 minutes to load a two yard wagon in this way, and it was seldom that more than 60 loads per day could be loaded from one hopper.

There being a constant supply of compressed air on the work it was resorted to for relief in this case. A pipe was run from the compressor with a valve convenient for the men on the platform. A hose was attached to the pipe and at the end of it a piece of 1 inch pipe 4 or 5 feet long was fastened. This pipe was run down into the dirt and when the air was turned on it caused the material to slide freely and the wagon was quickly loaded. The number of wagons was at once increased and in ten hours from 100 to 120 wagons were loaded from each hopper.

The cost of the work was materially reduced by this means—blown away, we might say—as the number of teams was doubled and the daily excavation considerably increased, thus saving on the fixed charges. The labor of nine men was saved on the three hoppers. The cost of the air was scarcely appreciable in comparison with the results. A 2 inch pipe ran from the compressor with air at 80 lbs., but the jet was used only a small portion of the time.

QUESTIONS AND ANSWERS

W. G. C., Savannah, Ga. *Q.* In the little article in your August issue on "Record Driving in South African Mines," it is stated that with the air at 80 lbs. gage, at the surface the working pressure at the drills was not less than that, notwithstanding the usual reduction of pressure due to the friction in the pipes. The gain in air pressure at about 4,000 feet, it was stated, equals 10 lbs. per sq. in. Some months ago in Compressed Air a rule was given for roughly approximating the pressures of air at different depths, which was to add 20 per cent. to the absolute pressure for each mile of depth. Then 20 per cent. of 14.7 would be 2.94 lbs., and for 4,000 feet, or say ¾ mile, it would be only 2.2 lbs. instead of 10 lbs. Which is correct?

A. Both are approximately correct, one of them for atmospheric air and the other for air compressed to a specified pressure. The weight of a cubic foot of air at normal pressure and at 60 degrees, Fahr., is .0764 lb., and as 80 lbs. gage is 6.44 atmos., the weight of a cubic foot at that pressure would be $.0764 \times 6.44 = .492$ lb. Say that we had a pipe with a sectional area of 1 square foot, 144 sq. in., and with a vertical height of 4,000 feet, then the weight of the air in the pipe, independently of any pressure above it, would be $4{,}000 \times .492 = 1{,}968$ lb., and $1{,}968 \div 144 = 13.66$ lbs. per sq. in. The total weight would, indeed, be considerably more than this on account of the compression of the contents of the lower portions of the column by the weight of all above. Unless the piping were outrageously inadequate the loss by friction of flow should be much less than this, and there should be an effective working pressure of probably 90 lbs., while the atmospheric pressure at that depth against which the drills would deliver their exhaust would be only about 3 lbs. above the surface pressure.

TRADE PUBLICATIONS

PROGRESS REPORTER, No. 18, Niles.—Bement-Pond Co., New York. 20 pages, 9 by 12 inches. This shows a number of new tools recently turned out, a 90 inch Niles Tire Mill, a massive combination slotting, boring, drilling and milling machine, a 16-25-foot heavy pattern extension boring and turning mill, several new lathes and other tools.

WORKS AND PRODUCTS of Allis.—Chalmers Co: 48 pages, 5 by 6 inches. The seven plants of this company are illustrated, the aggregate floor space amounting to 74 acres, and the total ground area to 250 acres; the products mentioned include pumping engines, hydraulic turbines and centrifugal pumps, gas engines and power engines for all services, steam turbines, crushing, mining, floor mill and saw mill machinery and numerous other products.

RECORD, No. 65, Baldwin Locomotive Works, Philadelphia, 48 pages, 6x9 inches. This is a reprint of a paper on the Mallet Articulated Compound Locomotive read before the Engineers' Club of Philadelphia by Grafton Greenough, with discussion by S. M. Vanclain. Copiously illustrated and finely printed.

THE BARCO FLEXIBLE JOINT, Barco Brass and Joint Company, Chicago. 16 pages, 6x9 inches. This joint is described and shown in detail as to construction and a wide range of adaptability is suggested in the illustrations of the joint in actual use. Full dimensions of the different sizes are given.

BULLETINS 1—6, United Store Service and Tube Company, Boston. These bulletins describe cash carriers, parcel carriers, pneumatic despatch tubes, used in stores and factories and in connection with telegraph, postal and other service..

COAL HANDLING MACHINERY, Conveyors, "Industrial," "Railways," Stevedore Rope. C. W. Hunt Company, West New Brighton, N. Y. 48 pages, 6 by 3½ inches. "An introduction to the general line of labor saving machinery manufactured by the company." The pamphlets issued by this company make effective use of little half-tones, about 100 telling their stories in these pages.

THERE HAVE BEEN ISSUED recently by the Ingersoll Rand Company, 11 Broadway, New York, four pamphlets designated as follows: 36A, Compressors; 47A, Rock Excavating Machinery; 21A, Electric-Air Rock Drills and Channelers; 74B, Pneumatic Pumping Systems. These have each 24 pages, 6 by 3¼ inches and slip into a regular letter envelope or an inside pocket. They are copiously illustrated and contain in compact and handy form a great amount of essential information concerning the lines of apparatus indicated.

ALTITUDE STRENGTHENING THE HEART

The *Journal of Tropical Medicine and Hygiene* notes the fact that the Transvaal Medical Society has appointed a sub-committee to investigate the clinical and physiological effects of altitude upon persons resident in high localities, and says:

"The Transvaal is an upland, Johannesburg being some 6,000 ft. above sea level. The increased pulse-rate observable in the locality is attributed to altitude, and although it is said a healthy man can adapt himself to any degree of altitude, there is some doubt as to the scientific accuracy of this statement. The increased pulse-rate may require some hypertrophy of the heart muscle, a condition actually observed in a certain proportion of school children in Johannesburg schools. The importance of this condition would seem to centre chiefly around a question of longevity, and it would be interesting to determine the average length of life to which adults attain at these relatively high altitudes."

It is a fact that though Johannesburg is a young city, it already numbers among its inhabitants not a few men of advanced age who appear to be at least as active as those of similar years elsewhere. Longevity amongst the Boers, many of whom have lived nearly all their lives at altitudes similar to that of the Rand, is notorious. "Hypertrophy of the heart muscle" may sound very serious to the average layman, but in plain English it is nothing more than the strengthening of that organ to meet the needs of new conditions, or, in other words, it is the organism adapting itself to its environment. The change from low to high veld in South Africa often acts as a decided tonic, and should prove beneficial in the majority of cases even of impaired health, though where there is reason for doubt a medical man should certainly be consulted.

THE AERODROMETER

In the course of a research into the respiratory movements, Prof. Zwaardemaker, of Utrecht, has devised a very simple apparatus for determining the velocity of gas streams, an apparatus which seems to be capable of application for mechanical as well as for physiological experiments. This aerodromometer consists of a vertical glass tube, about 25 centimetres (10 inches) in length and 1 or 2 centime-

tres (0.4 to 0.8 inch) in diameter, in the middle of which a disc of aluminum is suspended by two spiral springs attached to the extremities of the tube. The air enters above through a number of inlet openings which nearly take up the whole of the cross section of the tube. The aluminum disc does not completely bar the passage, and an annular clearance is left between the disc and the cylindrical glass walls. When experimenting on the breath, the clearance is made rather wide—as much as 2.5 millimetres (0.1 inch)—not to obstruct the ment. When more powerful air currents are breath, which is very sensitive to any impedito be measured, the clearance may be reduced to 0.5 millimetre (0.02 inch) and the sensitiveness of the apparatus thereby be increased. The instrument is empirically gauged by means of a constant air current, produced, for instance, with the aid of a water-jet pump or an electric fan or blower; for the apparatus answers both for suction and pressure observations. The aerodromometer itself checks the constancy of the air-current to be measured. The deflections of the disc depend upon the velocity of the air-currents and upon the apparatus and its dimensions.

Using a tube with six inlet openings aggregating 0.93 square centimetre (0.144 sq. in.) and a clearance of 0.44 square contimetre (0.068 sq. in.) Zwaardemaker observed the following deflections, measured in millimetres, with air volumes measured in cubic centimetres per second:

1	millimetre..........	12	cubic	centimetres.
2	"	23	"	"
3	"	35	"	"
4	"	46	"	"
5	"	58	"	"
10	"	86	"	"
15	"	105	"	"
20	"	121	"	"
30	"	154	"	"
40	"	179	"	"
50	"	200	"	"

Further tests have been made with the aid of J. T. van Have's breath-volume recorder. Two of these latter instruments were placed on the two sides of a pendulum, 2.3 metres in length, in such a way that each oscillation of the pendulum sent an air-current through the Have instrument, which recorded the air-volumes. Each of these instruments was connected with an aerodromometer, whose oscillations were likewise photographically recorded. In this way two synchronous curves were obtained: a volume curve of the sine type, and a velocity curve of the cosine type. The two curves were found to be in complete accord, and it would thus appear that the aerodromometer, which is made by the firm of D. B. Kagenaar, sen., of Utrecht, is suited for recording the velocities of air-currents alternating in direction at a fairly rapid rate.

SCRUBBING BUILDING FRONTS

There has recently been adopted, for the first time in Edinburgh, a new method of cleaning and renewing the frontage of buildings. Hitherto of the systems employed, that of washing the face of the building with sandstone and water has found most favour. An innovation is now being carried out on the Union Bank in George street by Mr. W. Forrest, builder, Comiston-road. A double process of treatment is employed. First of all, the face of the structure is cleaned with carborundum. Made up in the form of briquettes, so as to be suitable for handling by workmen, it is applied by rubbing to the face of the stone. This having been done, the second stage of the cleaning operation is carried out in the application of a chemical composition named "Lithoderm." This substance searches the inner recesses that may have been missed in the first process, and the result of the whole is to give to the building thus treated a fresh, clean, and new appearance. *The Quarry*, London.

Can it be that these good people have never heard of the sand blast? They should have seen how the front of the New York City Hall was cleaned three or four years ago.

BLAUGAS

The rights to make and sell Blaugas in Canada and the United States have been secured by some Americans who propose to build a factory near Newark, N. J., where ground has been secured. The company was formed for the purpose of taking over and operating the patents of Herman Blau of Augsburg, Germany, covering the production and liquefaction of gas, derived from crude oil. This gas liquefies under compression to about 1-400 of of its original volume, and is then introduced into steel flasks, in which shape it is distributed to consumers. A committee of experts recent-

ly returned from Germany where they made a close investigation of the gas and its uses, and their report is commendatory. Blaugas is coming into general use abroad for all purposes for which ordinary gas is utilized. Besides its value for technical purposes, for which Blaugas commends itself on account of its high calorific properties, which make it valuable for welding, soldering, and the like, it is available for many uses out of reach of ordinary gas. In this direction Blaugas encroaches, to a considerable extent, on the field now exclusively enjoyed by electricity, principally in the matter of decorative effects. This comes very near encroaching on the preserves of compressed acetylene cylinders now so largely used on automobiles.

THE BIGGEST SEWER

The largest sewer in the world is in St. Louis. When the Harlem Creek sewer, now in process of construction, is completed, this city will possess a sewer with a large section of 29 feet diameter and smaller sections ranging from 27 to 18 feet in diameter, the main section and two branches measuring over four miles in extent, and the whole draining more than 6,000 acres of land. There are longer sewers than this, and there are drainage systems, not sewers, which drain much larger tracts of land, but there is no sewer in the world that combines such great size with extent of area drained, and there is no city drainage system in the world that in any way compares with it.

The Harlem Creek sewer was begun July 13, 1906, and Sewer Commissioner Fardwell expects to have the public section or that section running from Florissant avenue to the river completed within another year. The entire system will probably not be finished for three or four years more, and all the connecting lines will not be laid till the section drained becomes more thickly populated. The Harlem Creek District is the largest drainage area in the city, and that is why such a large sewer is being constructed. Over 800 of the 6,000 acres drained are outside the city limits, but the character of the land is such that its drainage had to be provided for in planning for a city sewer in the district adjacent to it. The natural slope of the ground sends all the water from Harlem Creek and its tributaries into the sink followed by the line of the sewer, and even though the city cannot run sewers outside the city limits, in this case it is compelled to take care of the drainage of a large section of land beyond the limits in order to protect the sewer area inside the city.

DRILL STEEL

At a recent meeting of the Chemical, Metallurgical and Mining Society of South Africa Mr. Lane Carter discussed the subject of economy in drill steel. By economy was not meant false economy. Cheap steel is usually the most expensive in the long run. It is much better to get a good quality of steel even if the first cost is high.

By sharpening drills underground vast economies could be effected. The recent experiments with an underground electric furnace show that this point is recognized, and no doubt the difficulties connected with it will be overcome at no distant date. The hoisting of all drills to the surface through 4,000 feet shafts in order to sharpen them is absurd on the face of it. A problem that has yet to be worked out is the question of the relative merits of machine sharpening and hand sharpening of drill steel. Mr. Lane Carter's experience is that hand sharpening pays best. It would surprise most people to know how much drill steel is lost underground. Kaffirs and Chinamen have a way of hiding steel. On every mine there are tons of steel stored away underground and lost for ever. This could be remedied by treating the hand men in the same way as the machine men, namely, by giving them all a certain number of drills with a distinctive mark and making them responsible for them. This scheme has been tried on one or two mines with great success. The initial expense of getting out sufficient steel is considerable, but the saving in the long run is enormous.

NOTES

The Cleveland-Cliffs Iron Company has decided to put in a Gayley dry-air blast plant at its Pioneer No. 2 furnace at Marquette, Mich. The work will be begun soon.

The Northwestern Iron Company has lately increased its capital, and has begun to make extensive improvement in its mines and its furnace at Mayville, Wis. Among these im-

provements will be a dry-air plant for the blast furnace.

The cost of pumping water, per million foot gallons at the different stations of the Metropolitan (Boston) water works during 1907, was as follows: Chestnut Hill high-service, 2.8 cents; Chestnut Hill low-service, 3.1 cents; Spot Pond, 3.4 cents; Arlington, 12.7 cents; West Roxbury, 21 cents. The average cost at all plants was 3.29 cents.

A large pneumatic tube is under construction in Chicago between the Union Stock Yards postal station and the offices of Armour & Co. This tube is to be approximately one-half mile in length, 20 in. in diameter and will accommodate a carrier holding the contents of an ordinary mail pouch.

Three men were killed by gas in the hold of the wrecked steamer "H. M. Whitney," of the Metropolitan Line, New York to Boston. They had been working on the vessel for a month, raising her from the bottom of Hell Gate Channel, New York Harbor, and had just succeeded. The three men entered the hold to examine it for tightness, but they failed to test the air before they went in, and were overcome before they could be rescued.

What is probably the shortest railroad ever built was put in in Armstrong county, Pa. It is known as the Pittsburg & Northeastern, and is owned by capitalists of Pittsburg opposed to the entrance of the New York Central into that territory. The tracks laid are two rail lengths long, the rails resting on 12 ties laid in the mud. It was necessary that some rail laying be done at once that the charter be kept alive. The new line claims to have the New York Central blocked from Pittsburg.

"Blowing up" is one of the accidents to which deep-water divers are most liable. When a diver is crawling on the bottom with his head down, air may accumulate in the back of his suit, and, getting to his legs, cause him to turn turtle and shoot helplessly upward, with the risk of coming into contact with a ship's or boat's bottom. To prevent such accidents the diving committee of the English Admirality has recommended that all new diving suits be provided with an arrangement for lacing up the legs and thighs.

A Vacuum Cesspool Exhauster in which the vacuum is created by a steam-ejector has been placed in service by the Epsom, England, Rural District Council. The vacuum tank, which has a capacity of 750 gal., is made of galvanized steel and is fitted with vacuum and level gauges. After the vacuum has been created the inlet pipe is put down into the cesspool and the valve opened, allowed the sewage to be drawn into the tank. The tank is mounted on a self-propelled truck containing a quick-steaming boiler. The traction gearing allows of speeds of one to five miles an hour.

An overlooked factory danger has been pointed out in Germany by Prof. M. M. Richter, who has found that machinery belts—especially in dry air and when rubbed with resinous substances—may become highly charged with electricity, and may give off sparks that, in an atmosphere laden with dust or combustible vapors, may produce a serious explosion. A five-inch belt running over a wheel making 600 to 2,000 revolutions a minute gave off a spark one to one and a half inches long. Coating the belts with bronze or aluminum powder proved an ineffective preventive, but acid-free glycerin, applied once a week, attracted moisture, and not only gave security against static charges, but increased the life of the leather.

In the construction of the Bank of Commerce Building at St. Louis some important problems of engineering were encountered. The discovery of quicksand underneath the site necessitated resort to compressed-air caisson work, with the result that the caissons, and consequently the foundations, have been sunk to solid rock, ranging from 60 to 70 feet below the street level. During this work it was necessary to put nine caissons under the south wall of the building on the north, within which heavy machinery closely placed made the work doubly difficult, though it was accomplished without the slightest damage to either the contents or wall of the structure. The latter has not settled a particle, though the deep boiler-rooms of the adjoining structures to the north and east had to be upheld during the process. In the course of this work the

vault foundations were placed for the bank, being heavy monoliths of reinforced concrete reaching nearly 20 feet below the floor of the basement of the bank. These rest on caissons, and the vaults when completed will be three stories high. They will be enclosed in the walls, running 12 feet below the water level of the city, and, through the caissons, will rest on solid rock.

Lime cartridges are often used in Europe in powderless coal mining. Pure carbonate of lime ground to a fine powder is made up into a cartridge 3 to 4½ in. long with a groove ½ in. in diameter on one side. An iron tube ½ in. in diameter, and perforated on the upper side, is inserted the whole length of the bore hole. This tube is inclosed in a calico bag which covers the perforations and one end of the tube, the other end is fitted out with a tap. The cartridges are then pushed to the back of the hole drilled for them and tamped as if they were gun powder. A small force pump is connected with the tap at the end of the tube by means of a short flexible pipe, and water equal in bulk to the quantity of lime used, is forced in. The water escapes through the perforations as it passes along the groove and the lime in the cartridge is saturated, the tap is closed steam is generated and the combination of generating steam and expanding lime brings down the coal.

LATEST U. S. PATENTS

Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D C.

JULY 7.

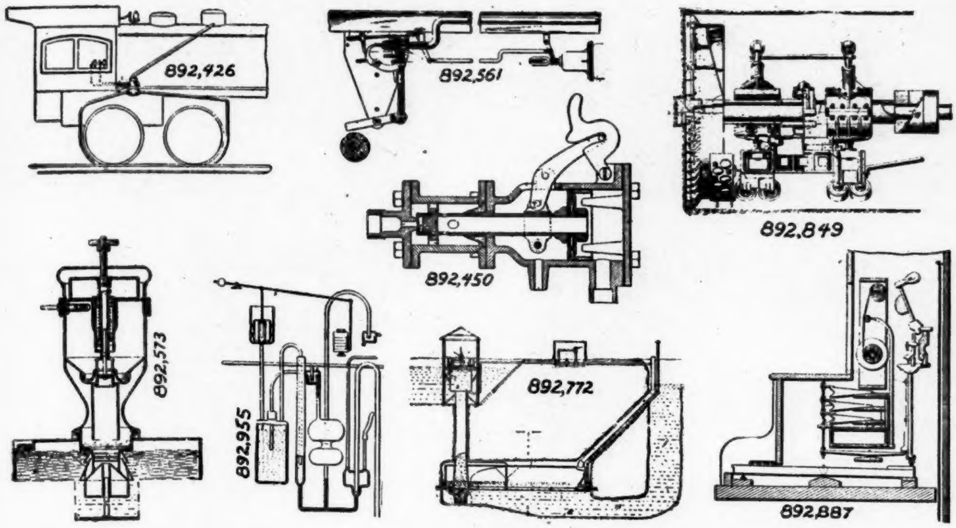
892,426. AIR-SANDER. WILLIAM HUGHES, Beaver Meadows, Pa.
892450. PRESSURE - REDUCING VALVE. THOMAS ROBINSON, Low Bentham, England.
892,561. AUTOMATIC AIR-BRAKE-PRESSURE ADJUSTER. ULYSSES S. SMITH, Sacramento, Cal.
892,573. ACETYLENE-GAS GENERATOR. CHARLES W. BECK, New York, N. Y.
892,772. HYDRAULIC AIR-COMPRESSOR. CHARLES H. TAYLOR, Westmount, Quebec, Canada.
892,849. DRILLING-MACHINE. TUNNEL BORING MACHINE. JOHN P. KARNS, Boulder, Colo.
892,887. PNEUMATIC PIANO-PLAYER. CLARENCE E. PRYOR, Binghamton, N. Y.
892,955. APPARATUS FOR GAS ANALYSIS. CARL A. HARTUNG, Berlin, Germany.

JULY 14.

892,974. AIR-PUMP. GEORGE P. ABORN, Boston, Mass.
1. A pump having a cylinder of two diameters, the upper larger portion forming an air cylinder and the lower smaller portion a water cylinder, upper and lower passages for admitting air and water to the air cylinder, a plunger in the air cylinder acting to open the air passage on its down stroke and the water passage on its up stroke for the admission of air and water, and to deliver air on the up stroke, and a smaller plunger for delivering water from the water cylinder on the down stroke.
893,000. VACUUM CLAMPING DEVICE FOR STAVE COLUMNS. GEORGE W. LOGGIE, Bellingham, Wash.
1. A vacuum clamping device used in manufacturing stave columns in which is combined means for holding a number of staves assembled in columnar form; means for hermetically sealing the ends of said stave columns; and means for exhausting the air from within said stave columns.
893,033. AUTOMATIC SPRINKLER APPARATUS. EVERETT L. THOMPSON, Dover, N. J.
893,038. AIR-PUMP FOR INFLATING PNEUMATIC TIRES. OCTAVE VADAM, Paris, France.
893,049. VENTILATING TUNNELS. HENRY BLACKMAN, New York, N. Y.
893,052. WINDMILL. JOHN A. CARLSON, Chicago, Ill.
893,101. CAN-TESTING MACHINE. FRANK RUDOLPHI, Chicago, and CHARLES J. NELSON, Maywood, Ill.
893,138. PNEUMATIC TOOL. HERBERT A. BROCKWAY, Denver, Colo.
893,192. HIGH-PRESSURE GAS-PRODUCER. EDWARD P. NOYES, Winchester, and SIDNEY A. REEVE, Worcester, Mass.
893,222. HYDRAULIC AIR-COMPRESSOR. PETER BERNSTEIN, Mulheim-on-the-Rhine, Germany.
893,261. VALVE MECHANISM FOR AIR-BRAKE APPARATUS. FRANKLIN A. PIERCE, Wheeling, W. Va.
893,296. PNEUMATIC IMPACT - TOOL. GEORGE L. BADGER, Quincy, Mass.
893,393. MEANS FOR CONTROLLING THE STROKE OF FLUID-OPERATED PISTONS. JOSEPH W. SMITH, Portland, Oreg.

JULY 21.

893,599. HYDROCARBON-BURNER. JOHN F. BARKER, Springfield, Mass.
1. In a hydro-carbon burner having in combination, a main body portion, a diaphragm dividing the same into two chambers, a barrel portion connected with the main body portion, a spider provided with passage-ways and communicating with one of said chambers, nozzles communicating with the passage-ways of the spider, and a plate provided with conical shaped openings carried by the barrel and into which the nozzles project, whereby upon the passage of the hydro-carbon liquid through the nozzles and atmospheric air under pressure through the conical-shaped openings in the plate, the liquid fuel will be atomized, as described.
893,605. WARNING-SIGNAL FOR AIR-BRAKE SYSTEMS. BENJAMIN BRILL, Jr., North Bay, Ontario, Canada.
893,614. ANGLE-COCK FOR AIR-BRAKE SYSTEMS. JAMES FALLON, North Bay, Ontario, Canada.
893,710. AUTOPNEUMATIC MUSIC-PLAYING INSTRUMENT. WALTER R. CRIPPEN, Cambridge, Mass.
893,712. STARTING DEVICE FOR EXPLOSIVE-ENGINES. JULIAN F. DENISON, New Haven, Conn.
893,733. AUTOMATIC APPARATUS FOR SUPPLYING AIR FOR MANY PURPOSES. WILLIAM HOOKER, South Melbourne, Victoria, Australia.
893,851. AIR-VALVE FOR AIR-COMPRESSORS. JOHN G. LEYNER, Denver, Colo.
893,852. AIR-VALVE FOR AIR-COMPRESSORS. JOHN G. LEYNER, Denver, Colo.
893,854. SUCTION APPARATUS FOR PENUMATIC CLEANING SYSTEMS. WILLIAM LOCKE, Westfield, and ELIAS B. DUNN, East Orange, N. J.
893,899. MOTOR OPERATED BY LIQUE-



Pneumatic Patents, July 7.

FIED CARBON DIOXID. Georges Brousseau, Agen, France.

893,913. FLUID-COMPRESSOR. Frank Felbinger, Milwaukee, Wis., and Alexander E. Cafmeyer, Chicago.

894,018. AUTOMATIC PRESSURE-CONTROLLING DEVICE. William F. Krichbaum, Newark, N. J.

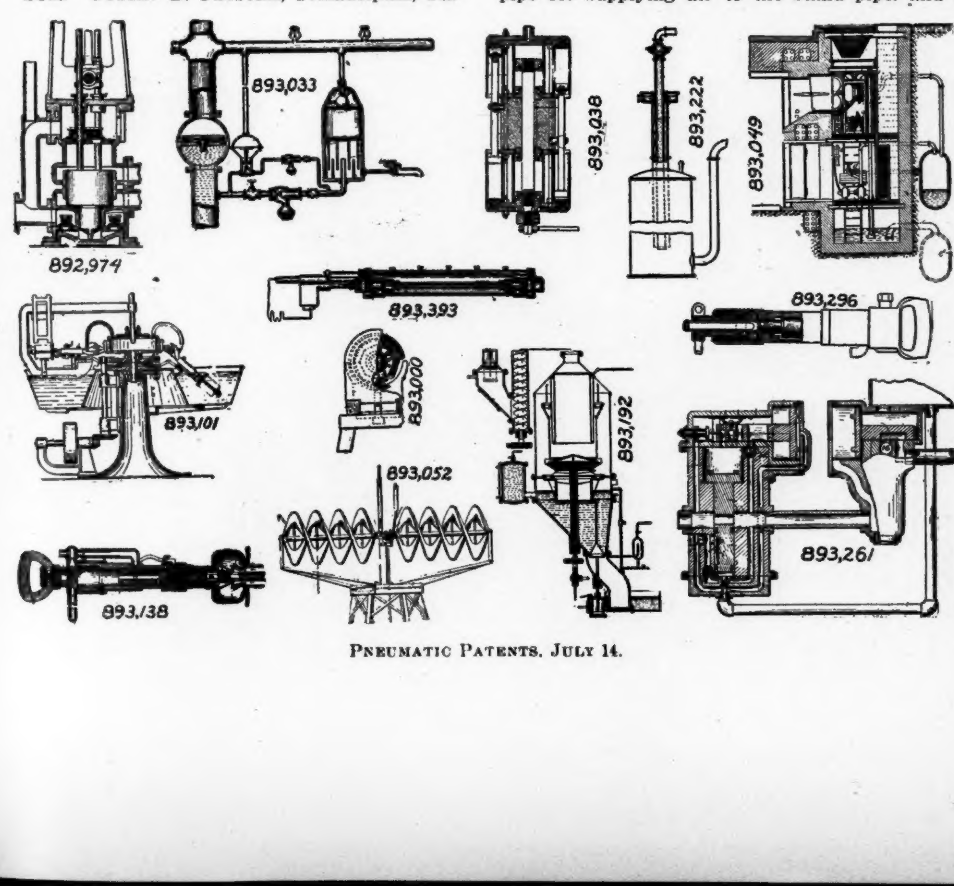
894,031. AIR AND LIKE PUMP. Donald B. Morison, Hartlepool, England.

894,047. GAS-ACTUATED BLOWING-ENGINE OR COMPRESSOR. Gustav B. Petsche, Phialdelphia, Pa.

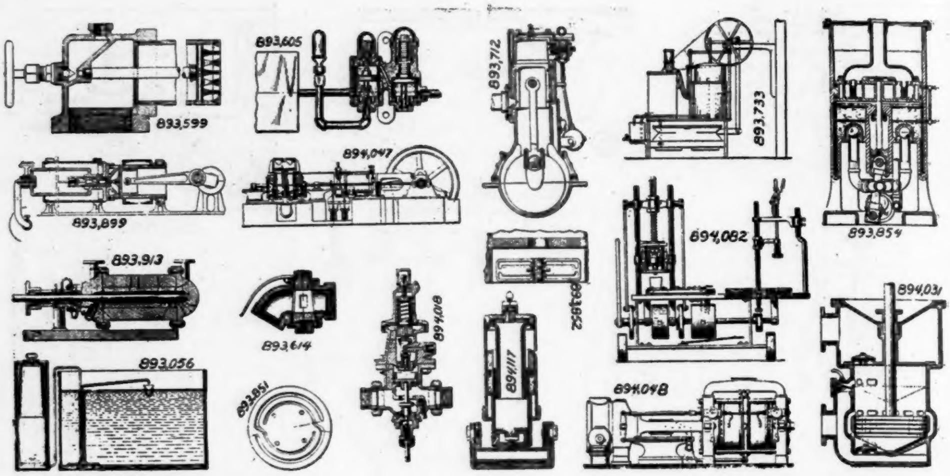
894,048. BLOWING-ENGINE OR COMPRESSOR. Gustav B. Petsche, Philadelphia, Pa.

894,056. AQUARIUM ATTACHMENT. Henry A. Rogers, Pagosa Junction, Colo.

The combination with an aquarium tank, of a stand pipe secured to the bottom of the tank, and communicated with the tank through an opening near the bottom of the pipe, said pipe having a plurality of chambers at its top, the chambers communicating with each other and with said opening of the stand pipe, a substantially horizontal pipe leading from one of said chambers and discharging into the tank above the level of the water therein, a pipe leading from the other chamber outside of the aquarium, means connected with the last named pipe for supplying air to the stand pipe, and a



Pneumatic Patents, July 14.



PNEUMATIC PATENTS, JULY 21

strainer below the open end of the horizontal pipe.

894,082. GLASS-BLOWING MACHINE. WILLIAM S. TEEPLE, Wellsburg, W. Va.

894,117. PNEUMATIC SUSPENSION MEANS. JAMES H. CLARK, Richmond, Va.

JULY 28.

894,204. RAILWAY SAFETY APPLIANCE. MICHAEL E. HOGAN, Chicago, Ill.

894,213. ROCK-DRILL. HENRY J. C. KEYMER, Gorleston, Great Yarmouth, England.

894,272. SAND-BLAST APPARATUS. ALBERT JORN, Jr.. Waukegan, Ill.

894,280. ENGINEER'S VALVE FOR COMPRESSED - AIR - OPERATED DUMP-CARS. THOMAS R. MCKNIGHT, Aurora, Ill.

894,493. PNEUMATIC CUSHION FOR VEHICLES. EDWARD A. GARVEY and CHRISTOPHER A. GARVEY, St. Louis, Mo.

894,546. PNEUMATIC-ACTION FOR MUSICAL INSTRUMENTS. EDWARD A. STEEL, Detroit, Mich.

894,586. PNEUMATIC PUMP. ALBERT BREST, New Castle, Pa.

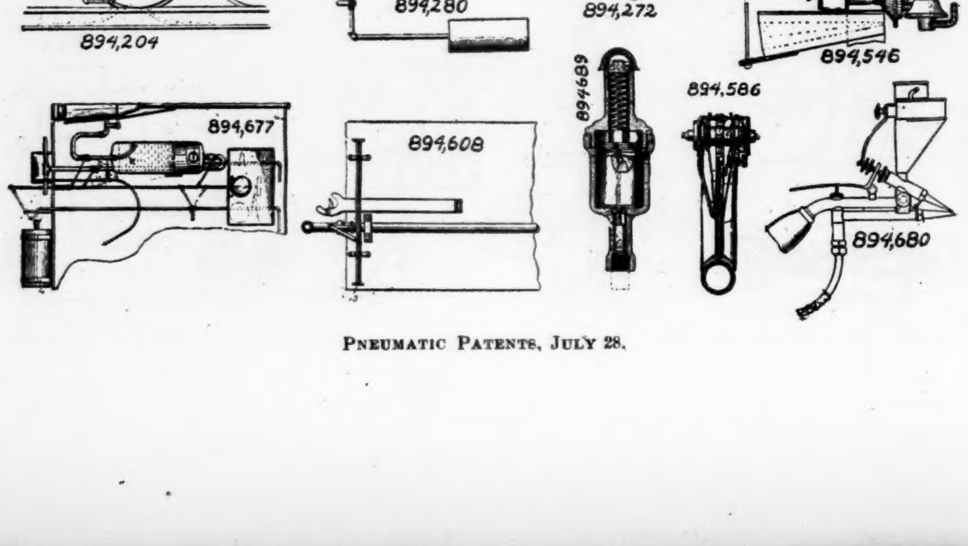
894,608. AIR-BRAKE SYSTEM. WILLIAM T. CRUMPLER and JOSEPH L. CRISLER, Pittsburg, Kans.

894,677. FIRE-EXTINGUISHER. NORRIS P. MATLOCK, Chickasha, Okla.

1. In a device of the class described, a reservoir containing a fire extinguisher liquid and normally communicating with the main pipe of the air brake system, whereby said reservoir is maintained at all times under air pressure said reservoir having a normally closed outlet.

894,680. PAINT-SPRAYER. HANS MIKOREY, Schoneberg, near Berlin, Germany.

894,689. AUTOMATIC PRESSURE-RETAINING VALVE FOR AIR-BRAKE SYSTEMS. JAMES D. NICHOL, Finley, Wash.



PNEUMATIC PATENTS, JULY 28.